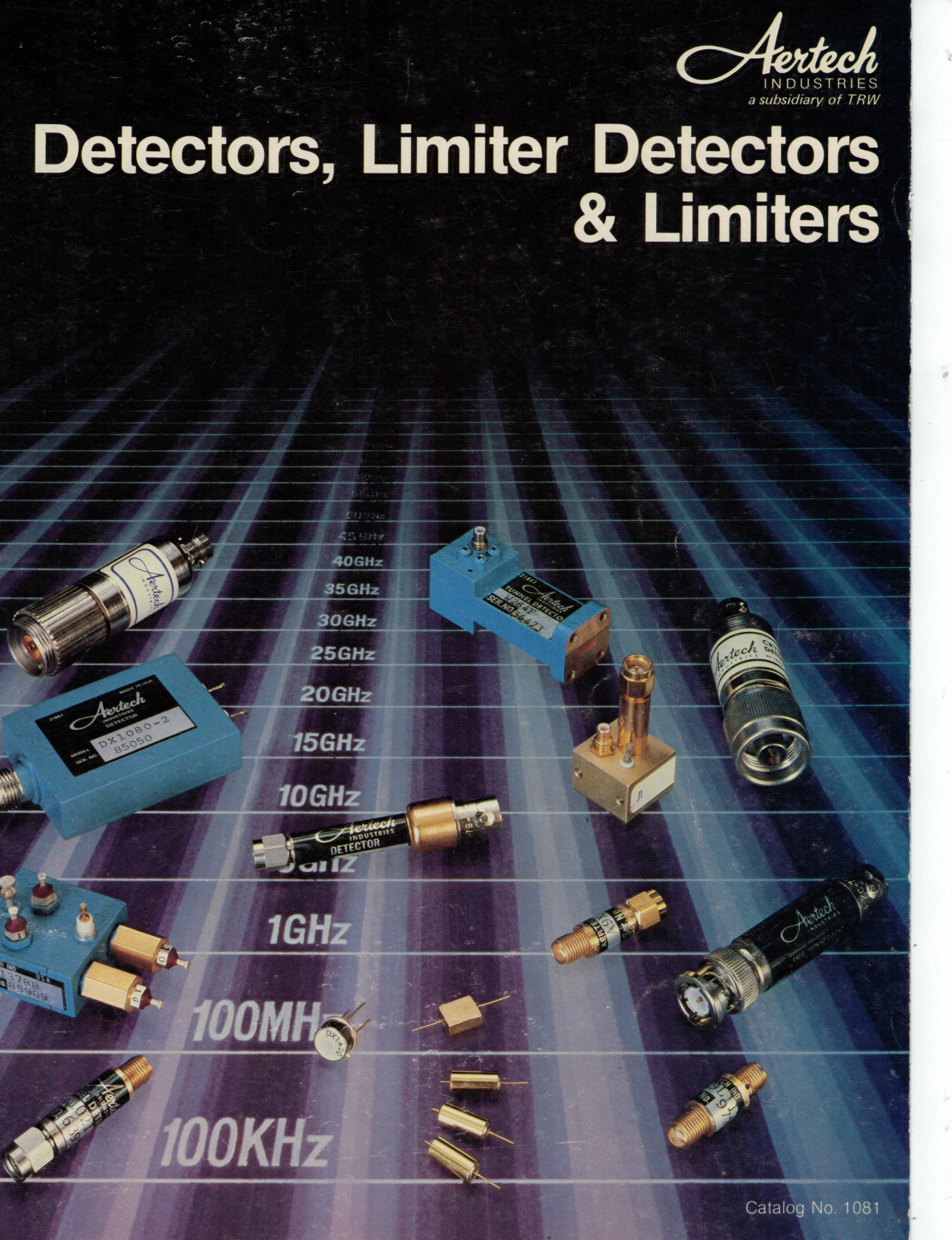
Aertech
INDUSTRIES
a subsidiary of TRW

Detectors, Limiter Detectors & Limiters



Catalog No. 1081

Contents

For Environmental Conditions, See Page 32

Aertech Detectors & Limiters

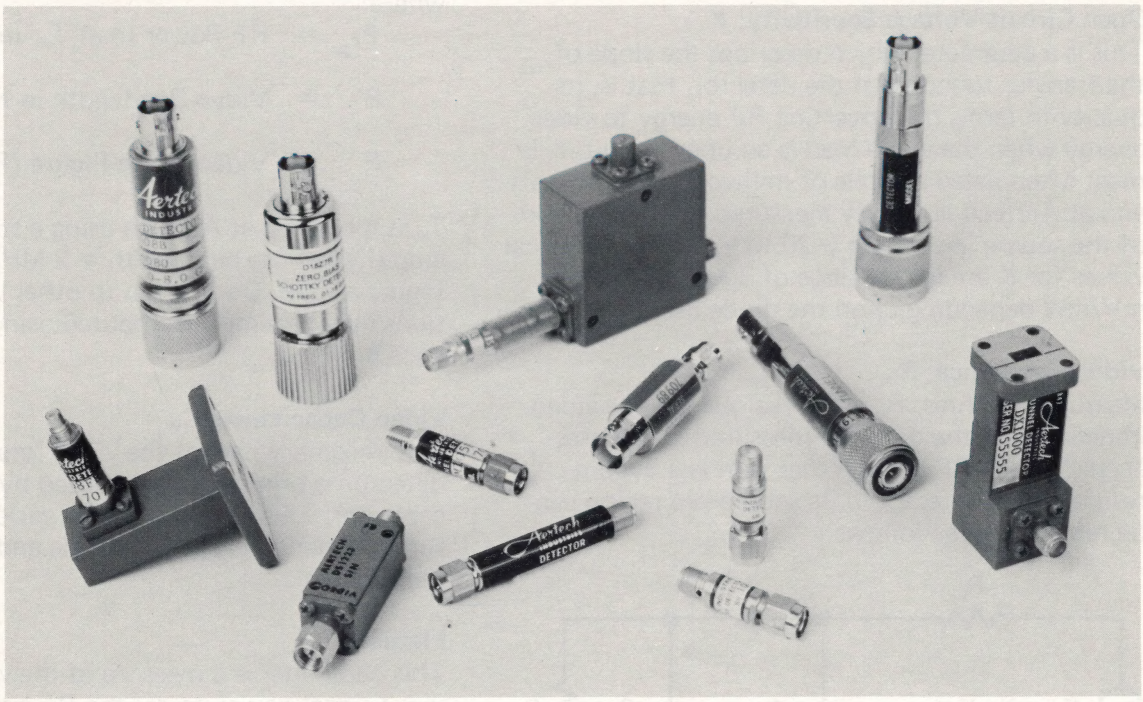
Aertech Industries produces a broad line of detectors, and limiters to serve the electronic warfare, telemetry, radar and communications markets. In addition, we have extensive experience in producing "hi-rel" products for satellite communications. Our product line presently includes tunnel diode, Schottky barrier diode and zero bias Schottky diode detectors, as well as limiters.

Aertech's state-of-the-art design and production techniques are supported by a team of experienced engineers, highly trained technicians and assemblers and modern production facilities. Specialized automatic test equipment is utilized to expedite the testing process and permit rapid matching and screening of our detector products. Of special importance is Aertech's in-house semiconductor manufacturing facility which complements the detector production effort by providing devices including tunnel, Schottky barrier, PIN, and step recovery diodes. From the initial design phase through assembly and test, each Aertech product receives the careful attention required to provide an end item which is reliable, within specification, and delivered on time.

This brochure describes our overall capabilities and presents many of the standard products in our detector, and limiter lines. In addition, Aertech will design and produce custom devices to meet your particular specifications. We invite you to contact us for expert assistance in choosing the best product for your application.

Integrated Diode Products Numeric Index

Detectors
General Information



Aertech offers a broad range of detector products for use in microwave systems and laboratory applications. Thousands of these products are currently in use as low level detectors in radar warning receivers, in missile seekers, and jammers; as power monitors in transmitters and signal source leveling applications; and in laboratories as test instrumentation. Aertech has qualified detectors for almost every conceivable environment from laboratory to space borne satellite systems.

This catalog divides Aertech detector products into three general categories based upon the type of diode used. The detectors utilize either a Schottky diode, tunnel diode, or zero bias Schottky diode. Each type offers various features and advantages when used for Microwave signal detection.

To help select the detector best suited for a particular application, comparison features and information on how to specify a detector are provided on pages 4 through 9.

Tunnel Diode, Pages 10 through 13

- Least Temperature Variations in Output Response
- Shortest Rise and Fall Time Response
- Lowest Output (Video) Resistance
- No Bias Required

Schottky Barrier Diode, Pages 14 through 24

- Highest Output Sensitivity
- Best Tangential Signal Sensitivity
- Highest Burn-out Rating
- Available in Hermetically Sealed Module Form or with Connectors.

Zero Bias Schottky Diode, Page 25

- Best VSWR
- Flattest Output Response
- No Bias Required

How to Specify & Select Detectors

Included in this section are several selection guides which chart the relative performance parameters of the various types of Detectors manufactured at Aertech. Table 2 on page 7 provides a qualitative guide for the selection of a component for use in low level detection applications such as crystal video receivers while Table 1 presents a comparison of performance for various diode detectors.

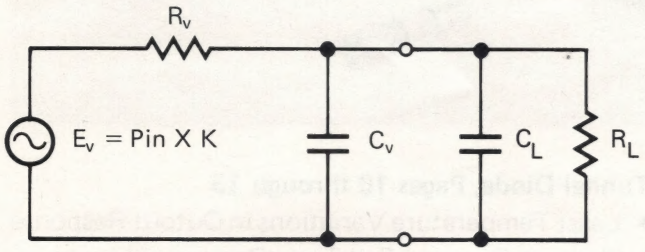
Detector Terminology

Open Circuit Voltage Sensitivity; K

This is a parameter which describes the slope of the transfer function of the detector, that is, its quality in terms of converting RF energy to video energy when the video load is an open circuit. K is most often listed in units of millivolts per milliwatt and at Aertech is usually measured at the high end of the square law region (-20 to -23 dBm). Typical values for K are in the range of 300 to 2000 mV/mW depending upon the diode used.

Video Resistance; R_v

Measured in ohms, R_v is the real part of the video impedance of the detector measured in the presence of input RF energy, that is, it is a dynamic resistance. A detector in its square law region can be represented as follows:



R_v can be measured by simply measuring the change in video output voltage when R_L is changed from one specific value to another. More simply one may decrease R_L from an open circuit (infinite) to the point at which the video voltage is ½ its open circuit value. At this point $R_L = R_v$. This measurement is usually made near the high end of the square law range (-20 to -23 dBm).

Figure of Merit; M

This parameter combines K and R_v into a form which gives the user a good indication of low level sensitivity without the need to consider the video circuit conditions. Since $M = \frac{K}{\sqrt{R_v}}$ is the denominator in the calculation of tangential sensitivity power input, higher M values indicate superior T_{ss} performance.

Tangential Sensitivity; T_{ss}

Tangential Sensitivity is a measure of the combined performance of a detector and video amplifier as a video receiver. It is a function of temperature, bandwidth and amplifier noise figure as well as M, the figure of merit of the detector. T_{ss} has become accepted as being that signal power which produces 8 dB signal-to-noise ratio. At 300° K (27° C)

$$P_{T_{ss}} = \frac{3.22\sqrt{BF}}{M} X10^{-7}$$

where:

$P_{T_{ss}}$ = RF Power In at T_{ss} in Milliwatts

B = Video Bandwidth in Hz

F = Video Noise Figure (Ratio)

T_{ss} is measured at Aertech using a standard video amplifier whose bandwidth = 2 MHz and Noise Figure = 3dB. Conversion to other video configurations may be simply computed using the graphs on page 8.

Video Capacitance; C_v

The imaginary part of the video impedance of the detector is primarily contributed by the RF bypass capacitor. This capacity can be varied in manufacturing depending upon rise time and bandwidth requirements.

Flatness

This parameter is a measure of the variation in input signal power across the RF band required to produce a constant video voltage output. This is usually measured at the high end of the square law region (-20 to -23 dBm) and for most model detectors is in the range of ±.2 dB to ±.5 dB.

Square Law Range

The video output power, over a given RF input power range is proportional to the square of the input signal power. This RF input range, usually from T_{ss} to about -20dBm is called the Square Law Range. Another way to define square law range is to say that it is the input power range over which the output voltage is directly proportional to the input power (K). This range can be extended using special techniques and proper choice of diode. Typical transfer function plots are shown in the appropriate sections for each detector type.

Rise Time-Video Bandwidth

In pulse response systems considerations of video pulse fidelity are of great importance and frequently require tradeoffs in T_{ss} via manipulation of the video bandwidth. The video bandwidth of the detector itself depends upon video impedance and varies greatly with the diode type selected and the RF bypass capacity used. The 10-90 per cent rise time for the voltage across the video load R_L due to a step voltage input is

$$t_r = \frac{.35}{B} = 2.2\left[\frac{R_v R_L}{R_v + R_L}\right] \times \left[C_v + C_L\right]$$

B = the 3dB video bandwidth in Hz

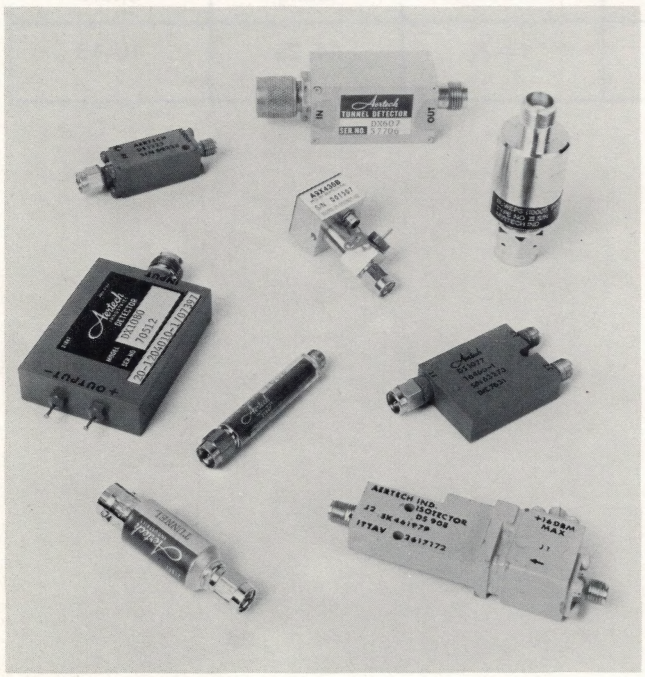
Curves for various R_L, R_v conditions are shown on page 9.

Dynamic Range

This parameter can be defined quite differently depending upon the application. Expressed in dB it can be the range of microwave input power from T_{ss} to either the point at which detector output deviates a given amount from square law or the point at which damage may occur. Protective devices such as limiters or attenuators can be added if input power is expected to be over approximately +20 dBm.

Transfer Function

This is the name given to the plot of output voltage as a function of input power for a given detector.



Special Detectors

Automatic Test Equipment

Temperature Stability

The variation in input signal power required to produce a constant video voltage output as the temperature is varied. This parameter, usually expressed in ±dB, is usually measured at the high end of the square law range (−20 to −23 dBm). While in many applications temperature compensation in video circuits following the detector can reduce the instability it should be noted that variations in video output vs temperature are usually not constant with varying RF input frequency.

Isolation

RF energy is bypassed to ground on the video side of the detector diode. The bypass capacitance is chosen to provide sufficient isolation (20 to 30 dB) between the RF and video ports. However, considerations of rise time and video bandwidth often require lower capacity with a corresponding sacrifice in isolation (and perhaps sensitivity).

VSWR

The Voltage Standing Wave Ratio at the RF input port varies greatly depending upon the diode type and input power level. Typically the VSWR is enhanced via bias application but deteriorates rapidly above the square law range. Application of padding and video loading are employed in instrumentation detectors to achieve acceptable VSWR values.

Table 1. Typical Performance Comparison of Microwave Detectors

(Over Octave Bands To 12.4GHz)

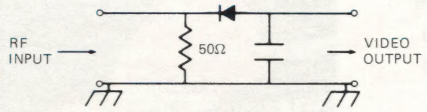
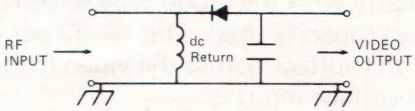
Detector Type Performance	Padded Biased Schottky	Padded Zero-Bias Schottky	Biased Schottky	Zero-Bias Schottky	Germanium Tunnel
Circuit Configuration					
Bias	20μA	0	100μA to 300μA	0	0
Tangential Sensitivity T_{SS} (2 MHz Video BW, NF = 3dB)	-47 dBm	-47 dBm	-52 dBm to -50 dBm	-52 dBm	-51 dBm to -49 dBm
Voltage Sensitivity K (mV/mW)	400 to 700	400	1200 to 2000	2000	400 to 1200
Video Resistance R_V (square law range) (ohms)	1000	5000 TYP	200 to 400	5000 TYP	60 to 120
Input VSWR (square law range)	1:5:1	1:5:1	2:1 to 4:1	9:1	1:5:1 to 2:1
Frequency Response (Flatness)	±.5 dB	±.5 dB	±.5 dB	±.5 dB	±.3 dB
Temperature Stability (-55°C to +85°C)	±1 dB	±2 dB	±1 dB	±2 dB	±.5 dB
Power Rating, CW	+23 dBm	+27 dBm	+20 dBm	+20 dBm	+17 dBm
Relative Rise and Decay Time	Moderate	Moderate Long	Moderate	Moderate Long	Short
See Pages	20	23, 25	14-22	24, 25	10-13

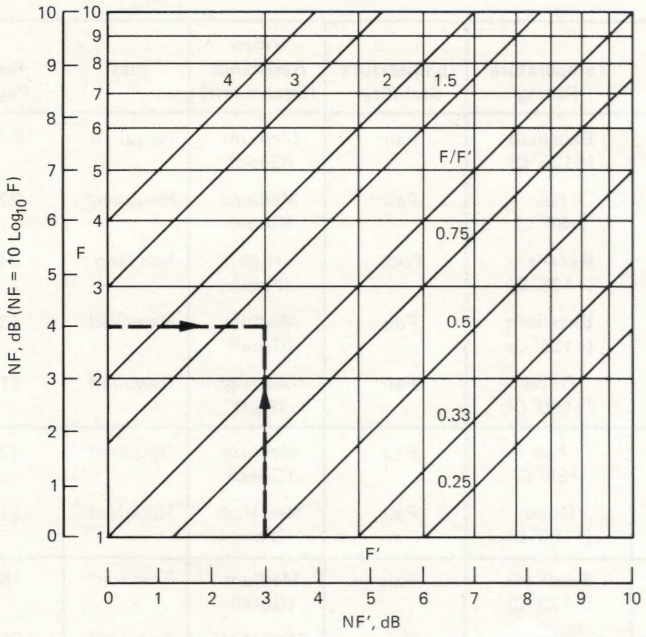
Table 2. Microwave Low-Level Signal Detector Selection Guide

First Choice of Performance	Type of Detector Recommended	T_{SS}	VSWR (Square law range)	Power Rating	Temperature Rating	Temperature Stability	Video Resistance (Square law)	Bias	See Page
T_{SS} (Tangential Sensitivity)	Regular Schottky	Excellent	Fair	Good	Excellent (+125°C)	Fair	Medium (Good)	Required	14–17
	Isotector	Excellent	Excellent	Good	Fair (+85°C)	Fair	Medium (Good)	Required	22
	Zero-bias Schottky	Excellent*	Poor	Good	Excellent (+125°C)	Poor	High (Poor)	Not Req.	24
	Limiter Schottky	Excellent to Good	Fair	Excellent	Excellent (+125°C)	Fair	Medium (Good)	Required	18
	Multi-diode Schottky	Excellent	Excellent	Excellent	Good (+100°C)	Fair	Med-High (Fair)	Required	21
VSWR (Square law range)	Isotector	Excellent	Excellent	Good	Fair (+85°C)	Fair	Medium (Good)	Required	22
	Multi-diode Schottky	Excellent	Excellent	Excellent	Good (+100°C)	Fair	Med-High (Fair)	Required	21
Power Rating	Limiter-Schottky	Excellent	Fair	Excellent	Excellent (+125°C)	Fair	Medium (Good)	Required	18
	Multi-diode Schottky	Excellent	Excellent	Excellent	Good (+100°C)	Fair	Med-High (Fair)	Required	21
Temperature Rating	Regular Schottky	Excellent	Fair	Good	Excellent (+125°C)	Fair	Medium (Good)	Required	14–17
	Zero-bias Schottky	Excellent*	Poor	Good	Excellent (+125°C)	Poor	High (Poor)	Not Req.	24
	Limiter-Schottky	Excellent to Good	Fair	Excellent	Excellent (+125°C)	Fair	Medium (Good)	Required	18
Temperature Stability	Tunnel	Good	Good	Poor	Fair (+85°C~+100°C)	Excellent	Low (Excellent)	Not Req.	10–13
Low Video Resistance	Tunnel	Good	Good	Poor	Fair (+85°C~+100°C)	Excellent	Low (Excellent)	Not Req.	10–13
No Biasing	Zero-bias Schottky	Excellent*	Poor	Good	Good (+125°C)	Poor	High (Poor)	Not Req.	24
	Tunnel	Good	Good	Poor	Fair (+85°C~+100°C)	Excellent	Low (Excellent)	Not Req.	10–13

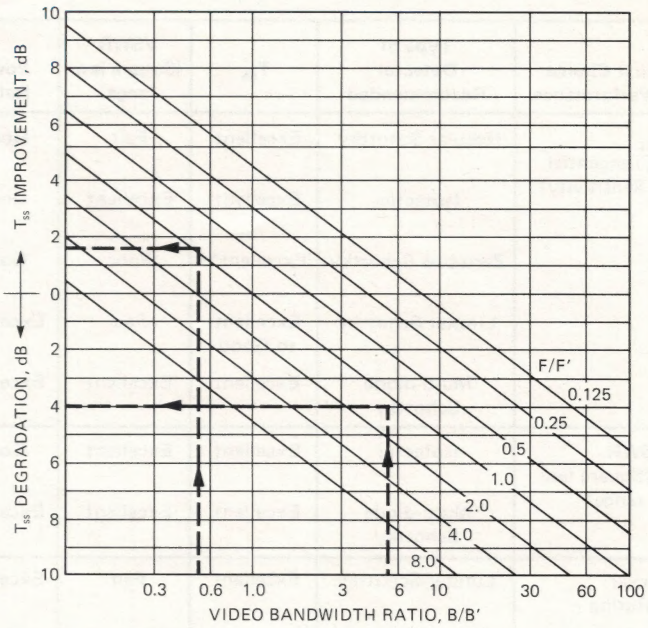
*Poor T_{SS} value at high temperature

Tangential Signal Sensitivity Conversions

Graph 1



Graph 2



All values of T_{ss} specified in this catalog were measured with a video amplifier with a bandwidth of 2 MHz and a noise figure of 3 dB. The curves above help to simplify the conversion to obtain T_{ss} under actual expected video conditions.

$$P_{T_{ss}} = \frac{3.22\sqrt{BF}}{M} \times 10^{-7}$$

$$T_{ss} = 10 \text{ Log}_{10} \frac{P_{T_{ss}}}{P_{Ref}} \propto 10 \text{ Log}_{10} \sqrt{BF}$$

Where $P_{T_{ss}}$ is the T_{ss} power level (in milliwatts); proportional to $\sqrt{BF}$

P_{Ref} is 1 mW; corresponds to 0 dBm.

B is the Video Amplifier Bandwidth (in Hz)

F is the Video Amplifier noise figure ratio (no units)

M is the Detector Figure of Merit = $K/\sqrt{R_V}$

Example Conversions

(Based on AERTECH A9D Series Detector Modules)
T_{ss}' = -52 dBm for B' = 2MHz, F' = 2 (NF' = 3dB)

1. Application dictates B = 10 MHz
   NF = 4dB

- Enter Graph 1 on vertical scale at NF = 4dB
- Enter Graph 1 on horizontal scale at NF' = 3dB
- Intersection yields F/F'≈ 1.3
- Take ratio of desired B to test condition B
  B/B' = 10MHz/2MHz = 5
- Enter Graph 2 on horizontal scale at 5
- Move vertically until F/F' ≈ 1.3 is reached
- Move horizontally to vertical scale; read T_{ss} degradation of 4dB
- New T_{ss} value is -48dBm in this application

2. Application dictates B = 1MHz
   NF = 3dB

- F/F' = NF/NF' = 1
- B/B' = 1MHz/2MHz = 0.5
- Enter Graph 2 on horizontal scale at 0.5
- Move vertically to F/F' = 1
- Move horizontally to vertical scale; read T_{ss} improvement of 1.5dB
- New T_{ss} value is -53.5dB in this application

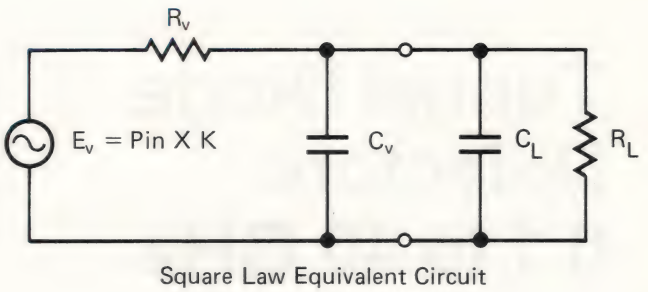
Note: A shorthand method for conversion is shown on page 32.

Microwave Detector Video Rise Time

Rise Time Equation

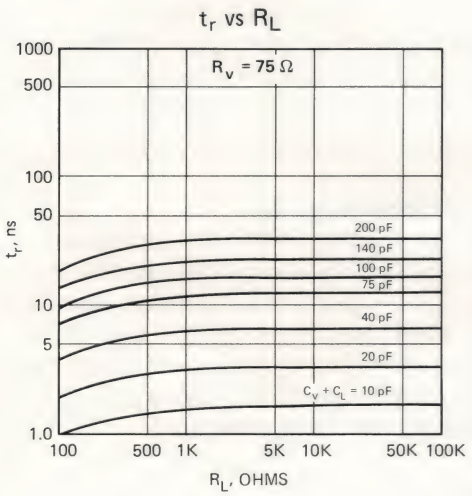
$$t_r(10\text{–}90\%) = 2.2 \times \left[\frac{R_v R_L}{R_v + R_L}\right] \times \left[C_v + C_L\right] = \frac{.35}{B}$$

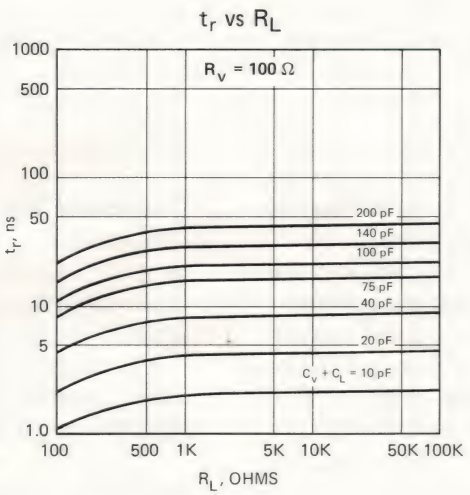
where R_v is the detector diode video resistance
C_v is the detector circuit bypass capacitor
C_L, R_L } the detector load capacitance and resistance
B is the 3dB Video Bandwidth in Hz

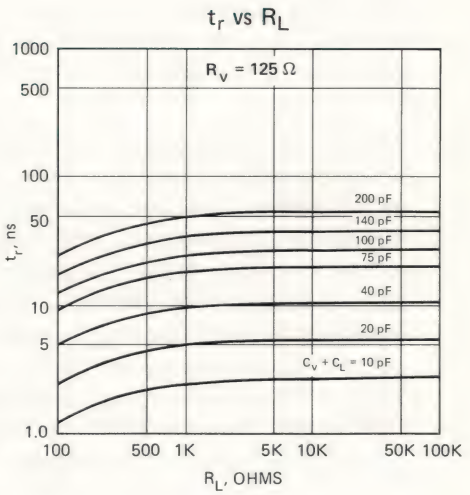


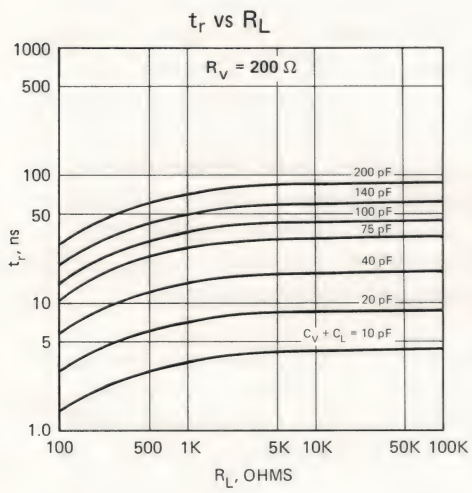
Square Law Equivalent Circuit

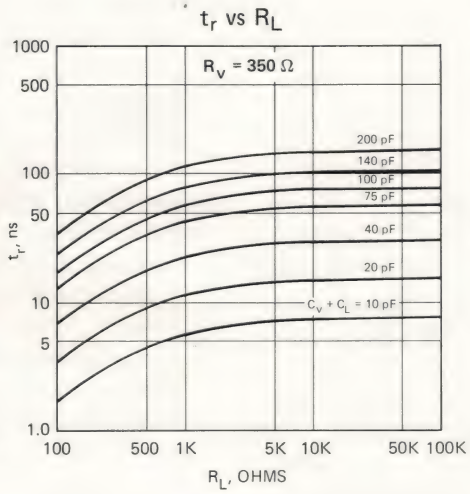
Typical values of R_v range from 75 to 125 ohms for tunnel diode detectors and 200 to 800 ohms for Schottky barrier diode detectors.

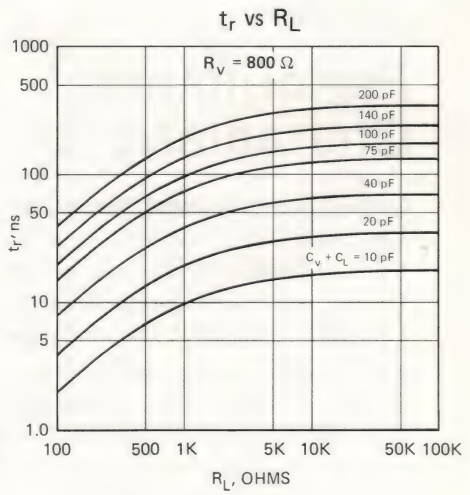












Tunnel Diode Detectors 0.1 to 40 GHz

Aertech's tunnel detector mounts are broadband matched without resistive loading, providing excellent sensitivity and flat response, with both tangential sensitivity and input VSWR, optimized. The detectors are available over octave and waveguide bands to 40GHz.

The tunnel detectors in this catalog are intended to cover the broadest range of system and laboratory applications. However, individual, unique requirements may and do exist, and these types of requirements have created a significant demand for special detector components. In response to this demand, Aertech engineers have for years specialized in the development of custom detector designs. These include units for operation in environments such as space borne, airborne, shipboard, etc. to rigorous military and Hi-Reliability specifications. Consult your Aertech representative for further information.

Performance Characteristics

Open Circuit Voltage Sensitivity; K

The open circuit voltage sensitivity, K, is approximately 1000 millivolts per milliwatt at 4GHz. This factor together with the low dynamic video resistance of the diode combine to provide significant improvements in tangential sensitivity (approximately 10dB for broadband systems) when properly integrated with a low noise video amplifier. This sensitivity improvement is particularly noticeable at low video frequencies (Doppler systems) in which 20-30dB sensitivity improvements are realized over point contact diodes due to the extremely low 1/f noise corner of the tunnel diode.

Rise Time; t_r

The performance of tunnel detectors in wideband video systems requiring fast pulse rise times is particularly noteworthy. The dynamic video resistance of the diodes is on the order of 100 ohms, and enables typical video bandwidths of 100MHz, with bandwidths up to ½ of the lower RF frequency available on special request.

Tangential Signal Sensitivity; T_{ss}

An important consideration in achieving detector-amplifier sensitivity is optimizing video amplifier noise figure as a function of detector video resistance. Transistor video amplifiers are quite suitable for such application, and noise figures <3.0dB are easily attainable for the source resistance (75 to 200 ohms) of the tunnel diode detector.

Dynamic Range

Tunnel detector square-law performance is essentially unaffected by changes in microwave power level at small signal levels ($P_{IN} \leqslant -23$dBm). At higher power levels there are necessarily deviations, since a strict adherence to square-law performance would require a conversion gain. Proper loading of the tunnel device can, however, extend square-law performance to beyond -15dBm, and dynamic ranges greater than 40dB are typically achievable in systems with bandwidths of several MHz.

A particularly convenient application of the tunnel detector is its use in conjunction with narrow band 1kHz amplifiers such as the HP415E SWR meter. On "low" input, excellent square-law performance is realized, and typical sensitivities are below –65 dBm.

1/f Noise Characteristics

The tunnel diode detector offers significant improvement for low-frequency narrow-band video applications where 1/f noise predominates. Tunnel detectors differ from crystal detectors in that the 1/f noise corner is as much as three decades in frequency below that of the crystal detector. This is due in part to the high doping levels and low resistivity of the back diode semiconductor wafer, and to the fact that no bias is required for normal operation. This physical characteristic of the tunnel detector can improve the sensitivity of video receivers below 100kHz; e.g., in Doppler radar systems, by 15 to 30dB, when the detector is properly integrated with a transistor video amplifier.

Temperature Stability

In addition to performing well in systems requiring large dynamic ranges, the tunnel detector displays excellent temperature stability characteristics. Although the I-V characteristic of the tunnel diode is affected by temperature variations, the greatest change occurs in the p-n junction current region beyond the valley voltages; by comparison, the tunneling region (where the detector operates under small signal conditions) is relatively independent of temperature. Typical variation in sensitivity for the tunnel detector is ±0.5dB over the temperature range from -65° to +85°C. This represents a considerable improvement over competitive crystal devices.

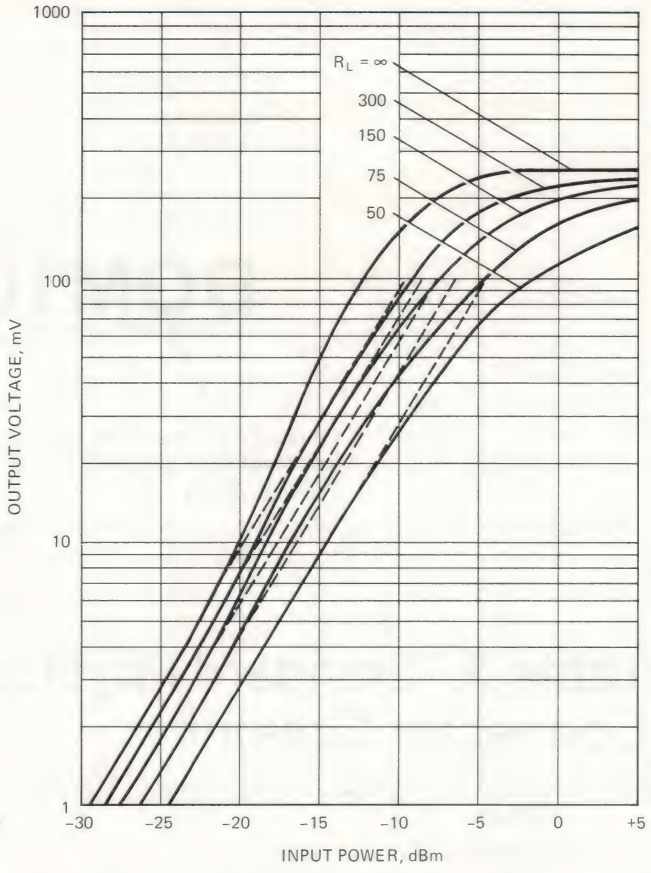
Application of Bias

A further microwave receiver consideration is that the tangential sensitivities mentioned herein are for unbiased tunnel detectors. This operational mode is generally optimal when sensitivity, VSWR, dynamic range, and system simplicity are all considered. When tangential sensitivity is of primary concern, improvements can be obtained by biasing the tunnel device to operate near the peak current. Increasing sensitivities, on the order of 2 to 5dB, can be realized in this manner, at the expense, however, of reduced dynamic range and increased RF mismatch.

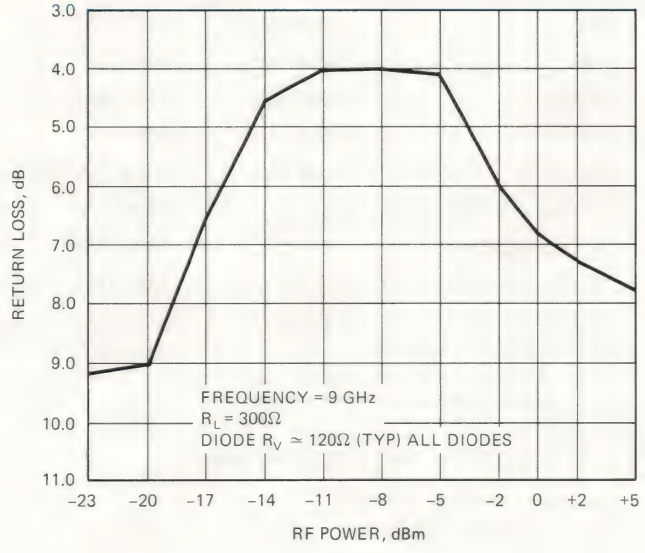
Power Handling Capabilities

The tunnel diode's power handling capabilities are higher than the point-contact crystals; however, because of the low resistance (100 ohms compared to 5,000 ohms) it is much easier to exceed the power ratings through transient voltages. For example, a capacitor charged to 10 volts will generate a peak power of approximately 1 watt when discharged through the tunnel detector and only about 20 milliwatts when discharged through the crystal detector. For high reliability application CW input powers should be kept below 50mW.

Typical Tunnel Detector Transfer Characteristics



Typical Tunnel Diode VSWR/Return Loss vs. RF Power



Part Number Code

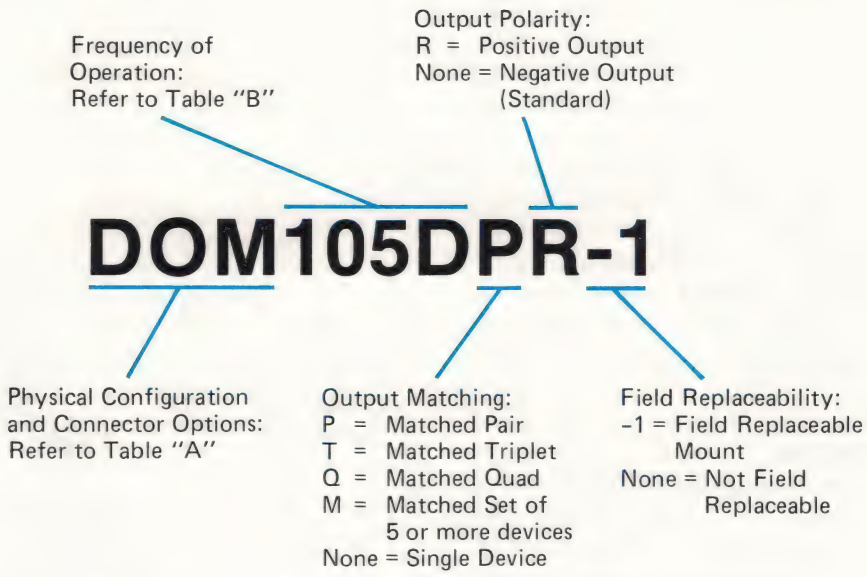


Table A. Standard Physical Configuration and Connector Options

Aertech Connector Series	RF	Video	Maximum RF Frequency GHz	Other Video Connectors Usually Available on Special Request	Outline See Page
D	N (M)	BNC (F)	12.4	TNC, Type N (M or F)	27
DT	TNC (M)	BNC (F)	12.4	TNC, Type N (M or F)	27
DB	BNC (M)	BNC (F)	4.0	TNC, Type N (M or F)	27
DM	SMA (M)	SMC (M)*	18.0	SMB (M), BNC	27
DO	SMA (M)	SMA (F)	18.0	TNC, BNC	27
DMM	SMA (M)	SMC (M)*	26.5	SMB (M)	27
DOM	SMA (M)	SMA (F)	26.5	TNC, BNC	27
DOZ**	SMA (M)	SMA (F)	18.0	---	27
W (for W812B)	RG-52/u	BNC (F)	12.4	SMC, TNC, SMA (F)	27
W (for W208F)	RG-91/u	SMC (M)*	18.0	SMB (M), SMA (F)	27
W (for W806F)	RG-66/u	SMC (M)*	26.5	SMB (M), SMA (F)	27
W (for W264F)	RG-96/u	SMC (M)*	40.0	SMB (M), SMA (F)	27

*Sealectro screw-on Con-Hex Series. Also mates with Amphenol Series 27.
** Available for 118B and 218B bands only.

Environmental:
All specifications are at room ambient temperature.
Maximum temperature range:
Storage -65°C to 100°C
Operating -65°C to 85°C

Table B. Electrical Specifications

	Frequency (GHz)	Type	Cap. (Max.) pF (C_v)	K (Min.)[5] mV/mW	M (Typ.)	Flatness Typical (dB)	T_{ss}[7] Typ. (dBm)	VSWR[5] (Max.)	VSWR Typ.
Standard Octaves	0.1-0.5	105D	500	1000	100	±0.2	–51	2.5	1.7
	0.5-1.0	510D	100	1000	100	±0.2	–51	2.5	1.7
	1.0-2.0	102B	50	1000	100	±0.2	–51	2.5	1.7
	2.0-4.0	204B	25	1000	100	±0.2	–51	2.0	1.5
	4.0-8.0	408B	15	700	70	±0.4	–50	2.5	1.7
	8.0-12.0	812B	15	700	70	±0.4	–50	2.5	1.7
	8.0-16.0	816B*	15	450	45	±0.6	–48	3.0	2.2
	12.0-18.0	208F*	7	400	40	±0.5	–48	2.5	2.0
	18.0-26.0	806F**	5	250	25	±1.0	–46	4.0	2.5
Broad Bands	0.1-1.0	110D	500	700	70	±0.5	–50	3.0	1.8
	0.5-2.0	520D	100	800	80	±0.5	–50	3.0	1.8
	0.7-1.4	714D	50	1000	100	±0.3	–51	2.0	1.5
	1.0-4.0	104B	50	800	80	±0.5	–50	3.0	2.0
	1.0-12.0	112B	25	500	50	±1.5	–50	4.0	2.5
	1.0-18.0	118B*††	20	400	40	±1.0	–46	4.5	3.0
	2.0-8.0	208B	25	600	60	±0.7	–50	3.5	2.0
	2.0-12.0	212B	20	500	50	±1.0	–50	4.0	3.0
	2.0-18.0	218B*††	20	400	40	±1.0	–48	4.5	3.0
	4.0-12.0	412B	15	600	60	±0.7	–48	3.5	2.0
	7.0-11.0	711B	15	700	70	±0.4	–50	2.5	1.8
	7.0-12.0	712B	15	600	60	±0.5	–50	3.0	2.0
Waveguide Mounted	8.2-12.4	W812B	15	700	70	±0.4	–50	2.0	1.7
	8.5-9.6	W8596B	15	1000	100	±0.2	–51	1.7	1.4
	12.0-18.0	W208F	7	500	50	±0.5	–48	2.5	2.0
	18.0-26.5	W806F	5	300	30	±0.5	–46	3.5	2.5
	26.5-40.0	W264F†	2	300	30	±0.5	–45	3.5	2.5

* Available only in DM, DO, DMM, and DOM Series.
** Available only in DMM, and DOM Series.
† Not available in field replaceable mount.
†† DOZ available only for 118B and 218B.

Technical Notes on Specifications:

1. Detectors can be matched within ±0.25 dB over octave bandwidths and ±0.4 dB over wider bandwidths. Sets of 5 or more can be matched to ±0.5 dB. Add the appropriate suffix letter to the part number for matched sets and 10% to the unit price.
2. The 1dB non-square-law point varies with the value of the video load. Typical values are –17dBm for open circuit and –12dBm for a 100-ohm video load.
3. No bias is required to obtain the performance specified. All standard models have a built-in DC return. Detectors can be supplied without DC returns on special request.
4. RF Power Input must be limited to 50mW, CW or 3 ergs spike. On models specified above 12GHz, power ratings are 10mW, CW or 1 erg spike. The video input must be limited to 0.5 volt forward voltage and 10mA reverse current. Forward voltage is defined as a negative voltage at the video connector for a forward (–) output detector. Voltage and power levels higher than those specified may result in permanent damage to the detector.
5. VSWR, K and flatness ratings are given for input powers from tangential sensitivity to –23dBm.
6. To order replacement diodes, consult factory.
7. BW = 2MHz, NF = 3dB @ ambient temperature. For conversion to other video conditions see the chart on page 8.
8. Normal video polarity is negative. Add the suffix "R" to the model number for positive polarity (no additional charge).

Schottky-Barrier Diode Detectors 0.1 to 40 GHz

High sensitivity and consistent junction characteristics make the Schottky-Barrier Diode an extremely desirable detection device. When the Schottky Diode is integrated with Aertech's unique coaxial tuned structure, the unit provides significantly improved performance, when compared with the point contact diode. The relatively low impedance of the device, i.e., 300Ω at a bias of 100μA, ensures low broadband SWR's and fast video response. The consistently low 1/f noise characteristic yields significantly improved performance in Doppler applications.

The Schottky Detectors in this catalog are intended to cover the broadest range of system and laboratory applications. However, individual, unique requirements may and do exist, and these types of requirements have created a significant demand for special detector components. In response to this demand, Aertech engineers have for years specialized in the development of custom detector designs. These include units for operation in environments such as space borne, airborne, shipboard, etc. to rigorous military and Hi-Reliability specifications. Consult your Aertech representative for further information.

In addition to devices using packaged diodes shown on pages 16 and 17 Aertech manufactures hermetically sealed coaxial modules which can be provided with connectors or with axial leads for use in stripline circuits. See pages 18 through 25.

Performance Characteristics

Dynamic Range

Another impressive feature of the Schottky Detector is the extremely wide dynamic range resulting from the relatively high breakdown voltage of the diode. Figure 1 shows the usable range to be from –55dBm (T_{ss}) to +20dBm (burnout). This provides an input power range of 75dB. As a square law device in the small signal region, the detector makes the transition to linear performance at approximately 0dBm. Deviation from square law operation (by 1dB) occurs typically at –14dBm for a 100Ω video load and 100μA bias. (Figure 4)

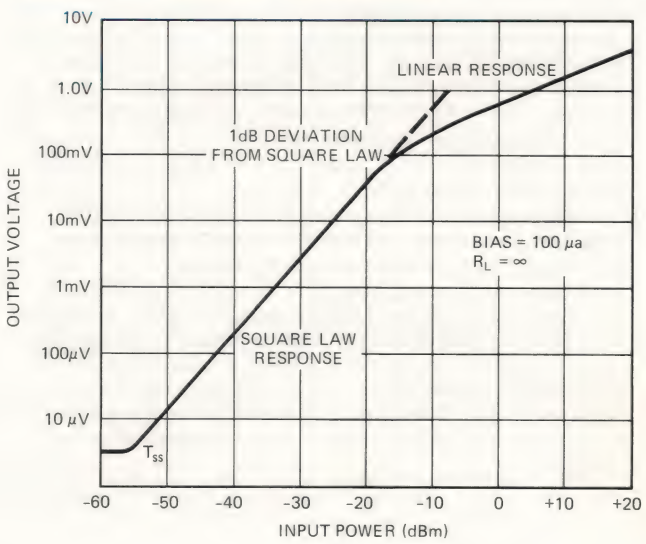
Square Law Performance

Square law performance data, showing the 1dB compression point as a function of bias, is shown in Figure 2 for typical pulse applications.

Sensitivity

The high rectification efficiency and low noise properties of the Schottky-Barrier Diode combine to provide an extremely sensitive video detection device. Tangential sensitivities of the Aertech models range typically from –51 to –55dBm (2MHz video bandwidth), as a function of the RF frequency and bandwidth. These figures compare favorably with those of the best point contact diodes; and of course, the Schottky Detector offers the additional advantages of lower 1/f noise, lower video impedance, wider video bandwidth, lower VSWR, higher burnout ratings, and repeatable performance.

Figure 1 — Transfer Characteristics



Although maximum rectification efficiency occurs at very low bias, the RF impedance of the diode at these levels is too high (Figure 2) to avoid excessive RF mismatch losses when the diode is mounted in a coaxial transmission line. In the case of the broadband detector, an RF matching structure is designed to minimize mismatch loss at a bias level where relatively high rectification efficiency and reasonably low video resistance can both be achieved. In most cases this has been accomplished at a bias level of 100μA and the video resistance is typically 300Ω. For narrow band, matching structures are optimized for bias currents in the 30 to 50μA range. Tangential sensitivity as a function of bias is shown in Figure 3.

Figure 2 – VSWR & Square Law vs. Bias

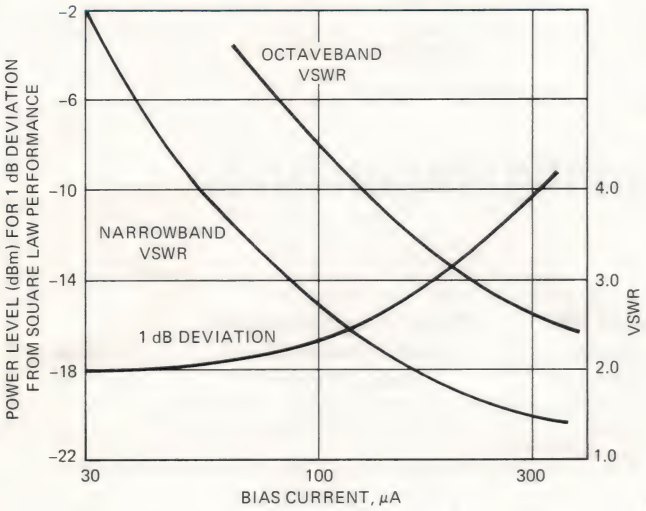


Figure 3 – Sensitivity vs. Bias

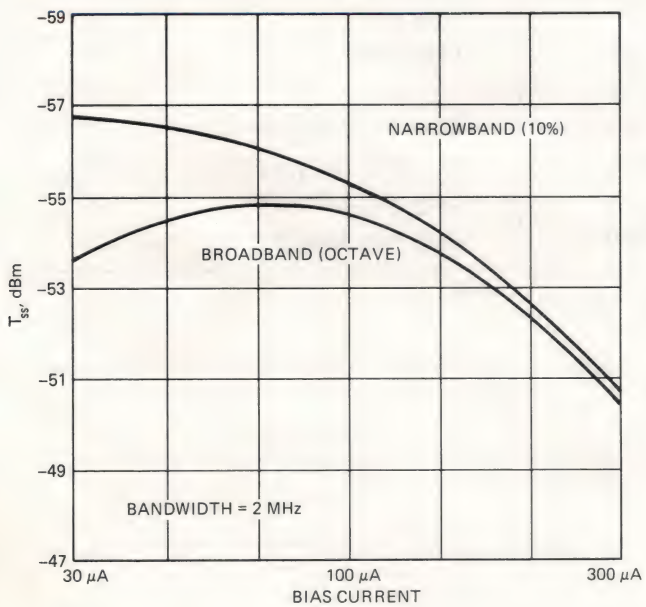
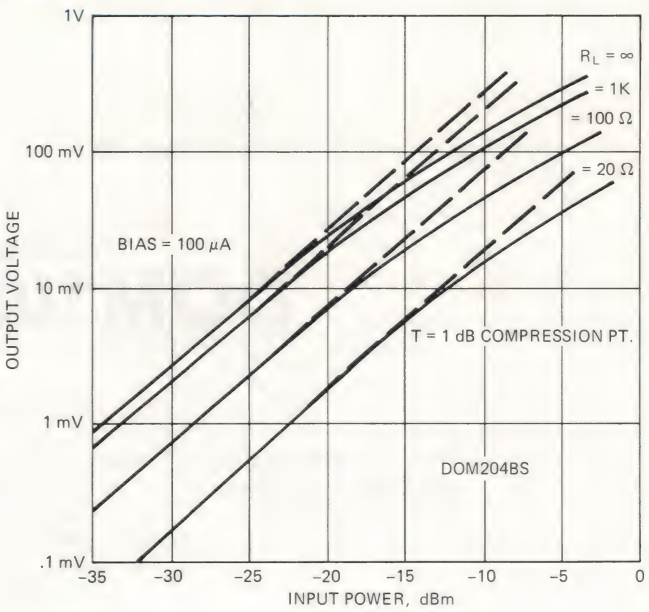


Figure 4 – V_O vs. P_{IN}



VSWR

Figure 2 presents a curve of typical input VSWR for a broadband Schottky Detector as a function of bias. As shown, extremely low VSWR's are possible at high bias levels (200-300μA). This is possible due to the lower diode junction resistance at these levels. However, improvement in VSWR must be accompanied by a loss in sensitivity as indicated in Figure 3 since increased shot noise, increased junction capacitance, and lower rectification efficiency all contribute to reduced signal-to-noise ratios.

Video Bandwidth

One of the significant advantages of Aertech's Schottky Detector over the conventional crystal detector is that its low video output resistance makes it ideally suited for wide video bandwidths. For example, the video bandwidth for Model D204BS is typically 42MHz for a load resistance of 300Ω and a load capacitance of 5pF. Under similar conditions, the 3dB bandwidth for the D812BS would be 70MHz. Wider bandwidths may be obtained by reducing the detector's video capacitance.

Part Number Code

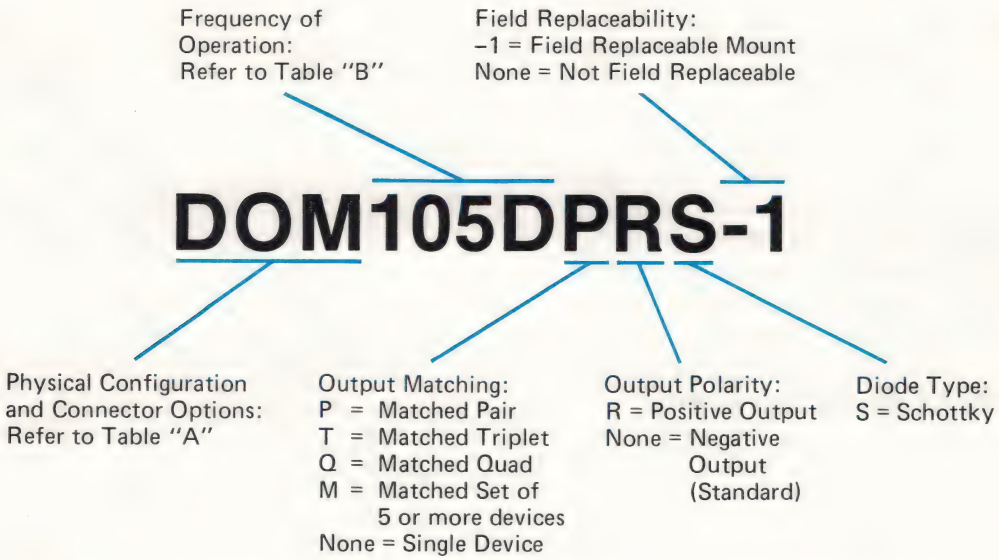


Table A. Standard Physical Configuration and Connector Options

Aertech Connector Series	RF	Video	Maximum RF Frequency GHz	Other Video Connectors Usually Available on Special Request	Outline See Page
D	N (M)	BNC (F)	12.4	TNC, Type N (M or F)	27
DT	TNC (M)	BNC (F)	12.4	TNC, Type N (M or F)	27
DB	BNC (M)	BNC (F)	4.0	TNC, Type N (M or F)	27
DM	SMA (M)	SMC (M)*	18.0	SMB (M)	27
DO	SMA (M)	SMA (F)	18.0	BNC, TNC	27
DMM	SMA (M)	SMC (M)*	26.5	SMB (M)	27
DOM	SMA (M)	SMA (F)	26.5	BNC, TNC	27
DOS**	SMA (M)	SMA (F)	26.5	---	27
W (for W812BS)	RG-52/u	BNC (F)	12.4	SMC, TNC, SMA (F)	27
W (for W208FS)	RG-91/u	SMC (M)*	18.0	SMB (M), SMA (F)	27
W (for W806FS)	RG-66/u	SMC (M)*	26.5	SMB (M), SMA (F)	27
W (for W264FS)	RG-96/u	SMC (M)*	40.0	SMB (M), SMA (F)	27

*Sealectro screw-on Con-Hex Series. Also mates with Amphenol Series 27.
**Available in 118B and 218B bands only.

Environmental:
All specifications are at room ambient temperature.
Maximum temperature range:
Storage -65°C to +125°C
Operating -65°C to +100°C

Table B. Electrical Specifications

	Frequency (GHz)	Type	Cap. (Cv) pF (Max.)	K (Typ.)[1,8] mV/mW	K (Min.)[1,8] mV/mW	Bias[3] (μA)	Typical[2] T_{ss} (dBm)
Standard Octaves	0.1-0.5	105DS	500	2500	2000	50	-54
	0.5-1.0	510DS	100	2500	2000	50	-54
	1.0-2.0	102BS	40	2500	2000	100	-54
	2.0-4.0	204BS	20	2500	2000	100	-54
	4.0-8.0	408BS	15	2500	2000	100	-54
	8.0-12.0	812BS	15	2500	2000	100	-53
	8.0-16.0	816BS**	10	2000	1600	100	-52
	12.0-18.0	208FS**	7	2000	1200	100	-52
	18.0-26.5	806FS**	5	900	700	100	-48
Broad Bands	0.1-1.0	110DS	500	2500	2000	50	-54
	0.5-2.0	520DS	100	3000	2000	50	-53
	1.0-12.0	112BS	25	1500	1000	200	-51
	1.0-18.0	118BS*	20	1500	1200	200	-50
	2.0-12.0	212BS	20	2000	1200	150	-52
	2.0-18.0	218BS*	20	1500	1000	150	-51
	1.0-4.0	104BS	40	2000	1500	150	-53
Narrow Bands	7.0-11.0	711BS	15	2500	2000	100	-53
	1.7-2.4	1724BS	20	5000	4000	50	-55
	2.2-2.3	2223BS	20	5000	4000	30	-55
	5.4-5.9	5459BS	15	4500	3500	50	-55
	7.5-8.5	7585BS	15	3000	2500	75	-55
	8.5-9.6	8596BS	15	3000	2500	75	-55
Waveguide Inputs	8.2-12.4	W812BS	15	2500	2000	100	-53
	8.5-9.6	W8596BS	15	3000	2500	75	-54
	12.0-18.0	W208FS	7	2000	1200	100	-52
	18.0-26.5	W806FS	5	900	700	100	-48
	26.5-40.0	W264FS†	2	900	700	100	-48

*Available in DO, DOM, DOS Series only.
**Available in DOM/DMM Series only.
†Not Available in Field Replaceable Diode Mount.

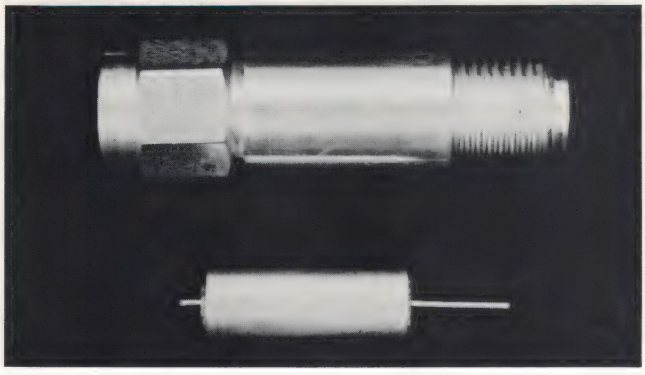
Technical Notes on Specifications

1. "K" is defined as the small signal open circuit voltage sensitivity, V_{out}/P_{in}.
2. BW = 2 MHz @ ambient temperature. Noise Figure = 3 dB.
3. May be adjusted to obtain increased sensitivity (lower bias) or reduced VSWR (higher bias). Figure 2, page 15, shows typical detector performance as a function of bias. Specifications apply for stated bias.
4. Normal video polarity is negative. Add the suffix "R" to the model number for positive polarity. (No additional charge.)
5. Detectors can be matched within ±0.25 dB over octave bandwidths and ±0.4 dB over wider bandwidths. Sets of 5 or more can be matched to ±0.5 dB. Add the appropriate suffix letter to the part number for matched sets and 10% to the unit price.
6. For special applications, many of Aertech's Schottky detector mounts are available featuring diode field replaceability. Diode replacement is accomplished by removal of the video connector, and no RF adjustments are required. These units may be specified by adding (-1) to the detector model number, and are available in most configurations with the exception of multi-octave, low capacity units. The additional charge for field replaceable mounts is $10 per unit.
7. To order replacement diode contact factory.
8. VSWR and K ratings are given for input powers from tangential sensitivity to -23dBm.

Special Applications

Limiter Detectors, 1W CW (Schottky Diode Detector) 2 to 18 GHz

Series A9A



Description

Aertech's A9A Series Limiter Detectors have been designed to virtually eliminate the performance degradation caused by the package parasitic reactances in conventional circuits. They have a hermetically sealed coaxial module to provide a broadband 50-ohm input impedance. Special detector diodes and limiter diodes are integrated with full RF matching, DC return, and video circuits to provide optimized broadband performance.

A9A Detectors are available in module form or with 3 mm RF and video connectors for high sensitivity, low VSWR, and wideband performance.

Environmental Ratings

Operating Temperature . . . . . –60°C to +150°C
Storage Temperature . . . . . –60°C to +150°C
Shock . . . . . 50 G, 11 msec
Vibration . . . . . 20 G, 100 to 2000 Hz

Refer to page 32 for MIL-STD-883 conditions.

Specifications at 25°C

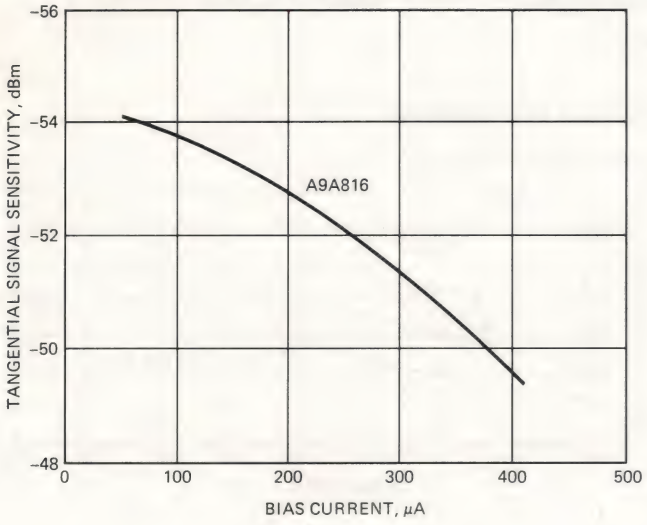
Frequency Range (GHz)	Model[1]		T_{ss}[3] (dBm)	K[4] (mV/mW)		VSWR[4] (Ratio)	R_v[4] (ohms)	Incident[5] RF Power Rating (watts)		Bias[6] (μA)
	Outline A[2,3]	Outline B[2,3]	Min.	Min.	Typ.	Max.	Typ.	CW	Peak	Typ.
2.0-4.0	A9A204A	A9A204B	–50	1000	1500	2.0	125	1	100	300
4.0-8.0	A9A408A	A9A408B	–50	1000	1500	2.0	125	1	100	300
8.0-12.0	A9A812A	A9A812B	–50	1000	1500	2.0	180	1	70	200
12.0-18.0	A9A128A	A9A128B	–49	800	1200	2.8	180	1	70	200
2.0-9.0	A9A209A	A9A209B	–50	1000	1500	2.0	150	1	100	250
8.0-16.0	A9A816A	A9A816B	–49	800	1200	2.8	180	1	70	200
7.0-18.0	A9A718A	A9A718B	–49	700	1200	3.0	180	1	70	200

Notes

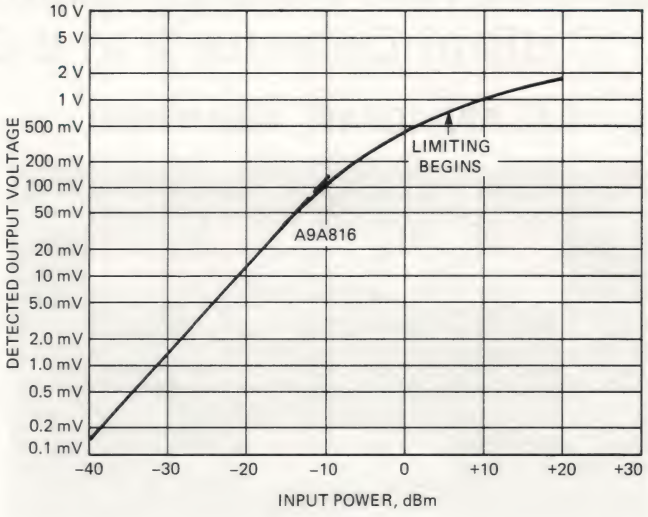
1. Typical video capacitance, 20 pF. Lower values available on special order.
2. Video voltage polarity indicated by suffix letter.
   Video Polarity — Suffix
   Positive — R
   Negative — None
   For Example A9A408AR
3. Outlines: See page 31 for A3 and B3 dimensions.
4. Video bandwidth 2 MHz, 8 dB signal-to-noise ratio, 3 dB video amplifier noise figure.
5. At specified bias current in square law region.
6. At 25°C. Derate to zero at +150°C. Peak power pulse width 1 μsec at 1% duty ratio.
7. Bias applied to video lead from external high impedance source. Bias polarity must be opposite of video polarity (example, negative bias for positive video).

Performance Characteristics @ +25°C (Test Conditions: R_L = 10K, Freq. = 10 GHz, and as noted)

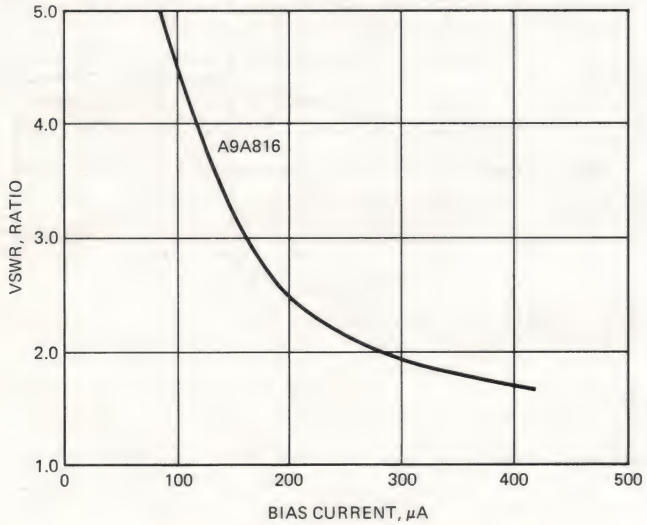
Typical Variation of T_{ss} With Bias (2 MHz Video Bandwidth)



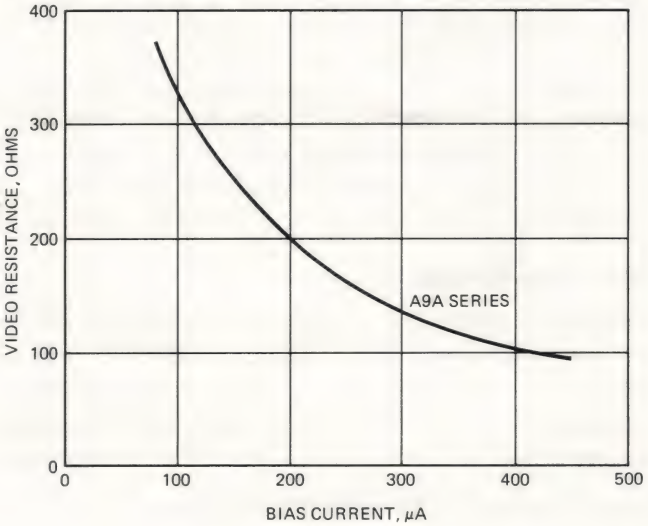
Typical Transfer Characteristics (250 μA Bias)



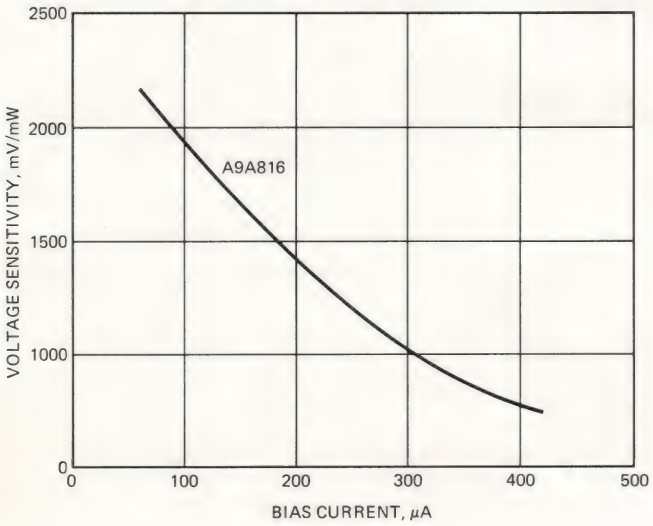
Typical Variation of VSWR With Bias (–20 dBm)



Typical Variation of Video Resistance With Bias



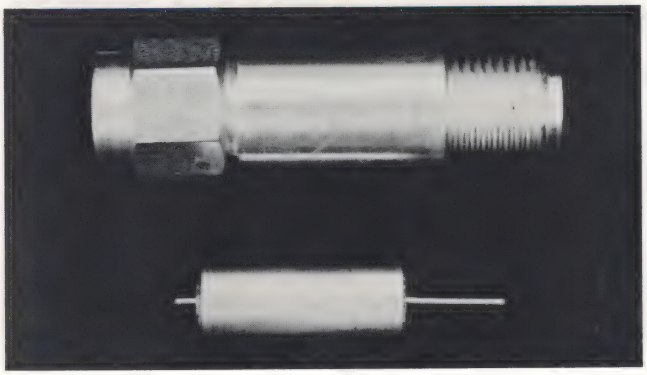
Typical Variation of Voltage Sensitivity With Bias



Special Applications

Low VSWR, Wide Dynamic Range (–46 dBm to +10 dBm) Detector 2 to 8 GHz

Models A9D100AR, A9D100BR



Description

The Aertech A9D100 Schottky diode detector is designed for low input VSWR over all of its dynamic range. The unit is specified to 8 GHz, but performs quite effectively to frequencies up to 18 GHz. The detector is available either in module form (Outline A) or with SMA connectors (Outline B).

Maximum Ratings

Operating Temperature: . . . . . –54°C to +125°C
Storage Temperature: . . . . . –54°C to +125°C
Shock . . . . . 50 g, 11 mSec.
Vibration: . . . . . 20 g, 100 to 2000 Hz
Input Power: . . . . . +23 dBm

Refer to page 32 for MIL-STD-883 conditions.

Specifications @ +25°C

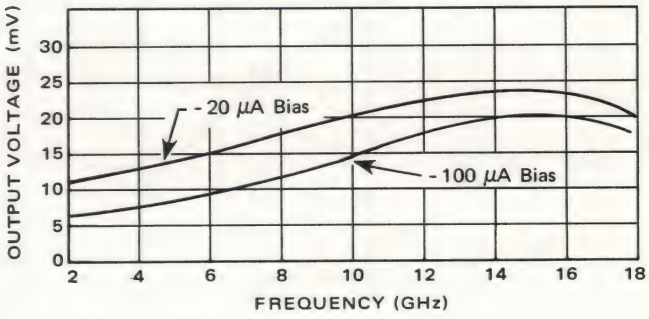
Frequency . . . . . 2 to 8 GHz
Output Polarity . . . . . Positive
T_{ss} (2 MHz, 3 dB Noise Figure) . . . . . –46 dBm

Bias	Sq. Law VSWR	+10 dBm VSWR	Output Voltage	Output Resistance
–20 μA	1.5:1 Max.	2:1 Max.	10 mV, Min.	1500 Ω Nom.
–100 μA	1.8:1 Max.	2:1 Max.	5 mV, Min.	400 Ω Nom.

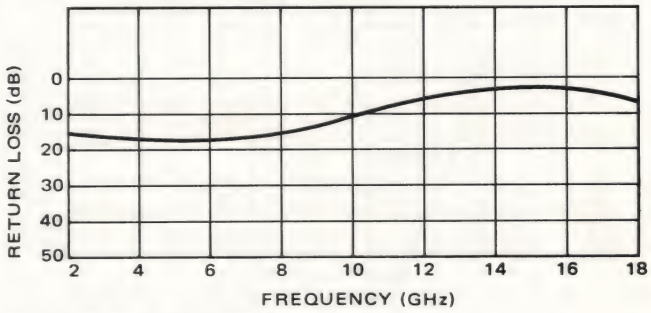
Outlines: See page 31 for A2 and B2 dimensions.

Typical Performance

Output VS. Frequency



Return Loss VS. Frequency.*



*Pin = -20dBm, R_L = 100 k OHMS.

Special Applications

Schottky-Barrier, Low VSWR High Sensitivity 4-Diode Detector

Model D4S

Features

- 0.1 to 4.0 GHz
- High Sensitivity
- High Power Rating
- Low VSWR
- Excellent Flatness
- Wide Square Law Range

Specifications

Frequency Range . . . . . 0.1 to 4.0 GHz

Flatness: . . . . . ±0.35 dB, Max.*

VSWR: (Input Power Level –17 dBm or Less) . . . . . 1.7 Max.*

Voltage Sensitivity (K): . . . . . 1800 mV/mW, Min.*

Tangential Sensitivity: . . . . . –55.5 dBm Min., 375 kHz Video Bandwidth
–52 dBm Min., 2 MHz Video Bandwidth

Square Law Range: . . . . T_{ss} to –10 dBm, with R_L = 2K Ω

Power Rating: . . . . . 400 mW CW, 3W Peak

Voltage Output @ P_{IN} = +20 dBm: . . . . 20 V Approx.**

Output Polarity: . . . . . Negative (Positive Optional)

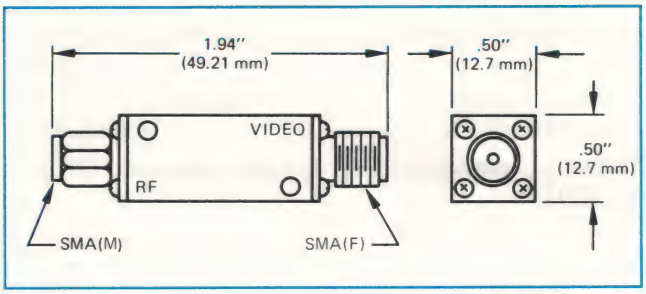
Input Connector: . . . . . 3 mm SMA Male (Female Available - D4SF)

Output Connector: . . . . . 3 mm SMA Female

Output Capacitance: (Typical) . . . . . 200 pF
(Lower Value Available for Higher Video Bandwidth)

*Bias @ 180 μA to 210 μA
**Open circuit load

Outline



Performance — P_{IN}, from T_{ss} to –17 dBm

Bias μA	Min. K (mV/mW)	Max. VSWR	Max. Flatness (dB)	Typical R_v (Ω)
50	5500	4.5	±0.8	2300
75	4500	4.0	±0.6	1600
100	3500	3.0	±0.5	1200
150	2200	2.4	±0.4	920
190	1800	1.7	±0.3	700

Special Applications

Schottky Diode Isotector (Isolator-Detector) 4 to 18 GHz

Models DIS408B, DIS812B, DIS816B, DIS108F

Features

- Optimized Interface Design
- Excellent T_{ss}
- Excellent VSWR TO +10 dBm
- Flat Output Performance
- High Power Rating (+20 dBm)

Typical Specification

Input Impedance . . . . . 50 ohms

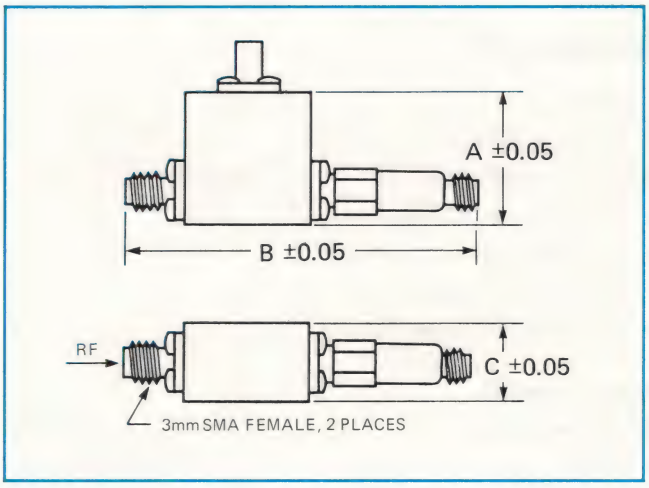
Output Capacitance (Typ) . . . . . 10 pF

Video Resistance (Nom) . . . . . 250 ohms, 200 μA bias
300 ohms, 100 μA bias
500 ohms, 50 μA bias

Output Polarity . . . . . Negative[1]

Maximum temperature range: Storage & operating -30°C to + 85°C.

Outline



Dimensions

Model	Dimensions (Inches)			Weight (Grams)
	A	B	C	
DIS408B	1.20	2.65	0.64	50, nom.
DIS812B	1.04	2.48	0.64	48, nom.
DIS816B	0.85	2.20	0.64	33, nom.
DIS108F	0.85	2.20	0.64	33, nom.

Special Performance

Model	Freq. Range (GHz)	Bias μA	T_{ss}[2] Min. (dBm)	Square Law Region			P_{IN} TO +10 dBm	
				K(mV/mW)[3] Min.	Flatness Max. (dB)	VSWR Max.	Flatness Max. (dB)	VSWR Max.
DIS408B	4-8	50	-54	2500	±1.0	1.5	±1.0	1.6
		100	-54	1700	±0.8	1.5	±1.0	1.6
		200	-52	1200	±0.5	1.5	±1.0	1.6
DIS812B	8-12.4	50	-54	2500	±0.8	1.4	±1.0	1.5
		100	-53	1750	±0.5	1.4	±1.0	1.5
		200	-51	1700	±0.5	1.4	±1.0	1.5
DIS816B	8-16	50	-53	2000	±1.0	1.6	±1.0	1.8
		100	-52	1500	±0.8	1.6	±1.0	1.8
		200	-50	1200	±0.8	1.6	±1.0	1.8
DIS108F	11-18	50	-54	2000	±1.0	1.6	±1.0	1.7
		100	-53	1500	±0.8	1.6	±1.0	1.7
		200	-51	1200	±0.5	1.6	±1.0	1.7

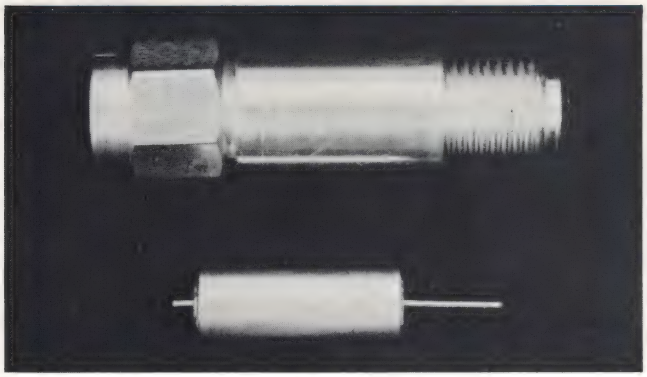
Notes:

1. Positive polarity models: DIS408BR, DIS812BR, DIS816BR, DIS108F.
2. 2 MHz video bandwidth, 3 dB noise figure, room ambient temperature.
3. Open circuit at room temperature.

Special Applications

Low VSWR, –15 dBm to +20 dBm Power Monitors 2 to 8 GHz

Models A9M100AR, A9M100BR



Description

The Aertech A9M100 Power Monitor is a Schottky diode detector designed for unbiased operation in the –15 dBm to +20 dBm input power range. The input VSWR of this power monitor is less than 1.5:1 over the 2 to 8 GHz frequency range and input power range specified. In addition, the unit performs effectively well beyond its specified RF frequency range to 18 GHz. The power monitor is available either in module form (Outline A) or with SMA connectors (Outline B).

Maximum Ratings

Operating Temperature:	–54°C to +125°C
Storage Temperature:	–54°C to +125°C
Shock:	50 g, 11 mSec.
Vibration:	20 g, 100 to 2000 Hz
Input Power:	+23 dBm

Specifications @ +25°C

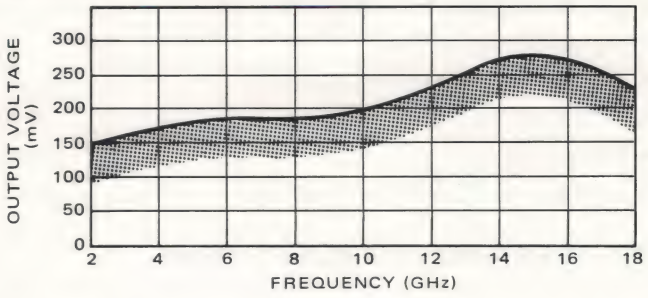
Output Polarity:	Positive
Frequency:	2 to 8 GHz
VSWR:	1.5, max.
Output*:	75 mV, min.

Outlines: See page 31 for A2 and B2 dimensions.

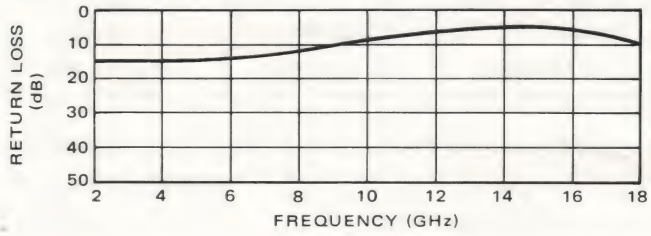
*P_{IN} = 0 dBm, R_L = 100,000 ohms

Typical Performance

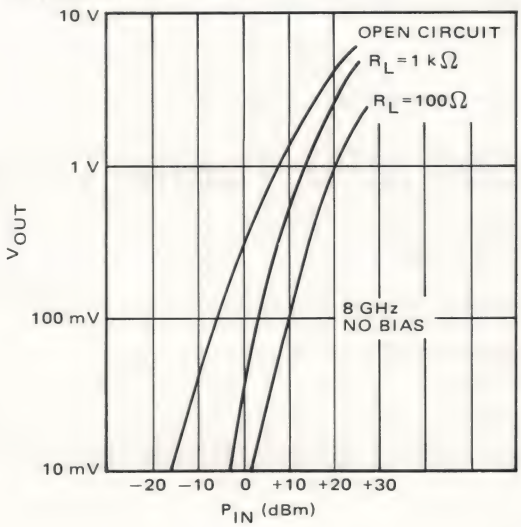
Output vs. Frequency*



Return Loss vs. Frequency*



Typical Transfer Curve



Special Applications

1 to 18 GHz Zero Bias Schottky Diode Detector

Model DOX118B, DOX218B

Features

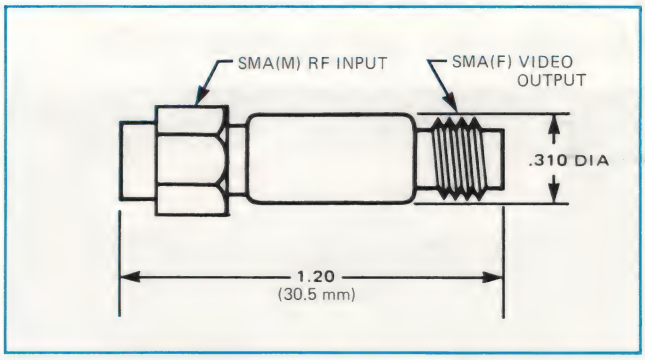
- No Bias Required
- Metallurgically Bonded Diode
- Excellent T_{ss}
- Moderate Video Resistance
- Flat Frequency Response
- Miniature Size
- Useable to 20 GHz and Above

Typical Performance @ Room Ambient

	2-18 GHz	1-18 GHz
Voltage sensitivity	1500 mV/mW Min.	1500 mV/mW Min.
Flatness	±1 dB Max.	±1 dB Max.
T_{ss} (2 MHz BW)	–52 dBm Min.	–51 dBm Min.

Output Capacitance (Typical) . . . . . 20 pF
Video Resistance . . . . . 3000 ohms, nominal
Maximum RF power (CW) . . . . . +20dBm
Temperature Sensitivity ±2.5 dB, –50°C to +125°C (Typ)
Output Polarity . . . . . Negative
Weight . . . . . 7 grams

Outline



Notes:
Positive output model - DOX118BR, DOX218BR
Field replaceable diode model - DOX118B-1, DOX218B-1
Field replacement diode - A1X494

5 to 2500 MHz Tunnel Diode Detector

Model DX1350

Features

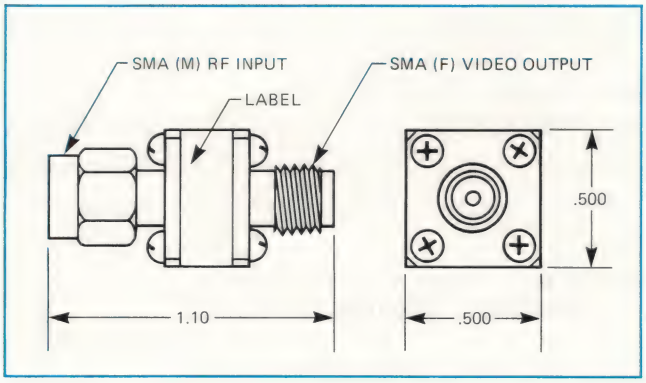
- Extremely Low Frequency
- Good Sensitivity
- Excellent T_{ss}
- Good Temperature Stability (–55°C to +85°C)

Specifications

Frequency . . . . . 5 to 2500 MHz
Voltage Sensitivity. . . . . 800 mV/mW Sq. Law Open Circuit Min.
Flatness. . . . . ±0.5dB Max.
VSWR. . . . . 2.0:1 Sq. Law Max.
Output Matching. . . . . ±.5dB Max.
Video Capacitance . . . . . 1000 pf (Typ)
T_{ss} . . . . . -54dBm (Typ)

Notes:
Matched units available: add "P" to model number
For positive output polarity: Model DX1350R

Outline



Special Applications

Zero Bias Schottky Diode Detector 100 kHz to 18 GHz

Series D10Z, D12Z, D18Z

Features

- Broadband
- Excellent Flatness
- Low VSWR
- No Bias Required
- Metallurgically Bonded Diode
- High Burnout Protection
- Choice of APC-7, Type N or SMA Input Connectors

Description

The Aertech D10Z, D12Z and D18Z Series of broadband coaxial detectors are designed for use in laboratory measurement, microwave instrumentation and broadband EW system applications. Since they do not require a dc bias and can be used with common oscilloscopes, their ease of use and broadband performance make them very useful measurement accessories. Their superior broadband flatness, VSWR, ruggedness and burnout protection, relative to point-contact models, make them excellent for microwave instrumentation and system applications.

The D18Z and D12Z Series include a choice of APC-7, Type N or SMA input connector models. All models have BNC female output connectors. Standard models have Negative output polarity with Positive polarity and matched pairs available as options.

Specifications*

Model Number	Connectors		Mech. Dimensions		Frequency Range	VSWR	Frequency Response		Low Level Sensitivity	Input Power
	Input	Output	Length	Diameter			Octave	Broadband		
D10Z	BNC Male	BNC Female	2.42 in (61mm)	0.51 in (13mm)	100kHz to 2.5 GHz	1.4:1 max	±0.1dB in any 100kHz increment +0.3dB to 2.5GHz		400mV/mW min.	Maximum Operating 200mW; Short Duration (Less than 1 minute) 1 Watt (typical)
D12Z7	APC-7		2.59 in (65.8 mm)	0.75 in (19mm)	10MHz to 12.4GHz	1.20:1 max (to 4.5GHz) 1.30:1 max (to 7GHz) 1.40:1 max (to12.4GHz)	±0.2dB	±.5dB (to 12.4GHz)		
D12ZN	Type N Male		2.46 in (62.5 mm)	0.75 in (19mm)						
D12Z3	SMA Male		2.50 in (64mm)	0.56 in (14mm)						
D18Z7	APC-7		2.59 in (65.8 mm)	0.75 in (19mm)	0.01 to 18GHz	1.2:1 (to4GHz) 1.4:1 to 18GHz)	±0.2dB (to 8GHz)	±0.3dB (to 8GHz) ±0.5dB (to 18GHz)		
D18ZN	Type N Male		2.46 in (62.5 mm)	0.75 in (19mm)		1.2:1 (to 4GHz) 1.4:1 (to 18GHz)				
D18Z3	SMA Male		2.50 in (64mm)	0.56 in (14mm)		1.2:1 (to 4GHz) 1.5:1 (to 18GHz)				

*Specifications given for T_A = +25°C

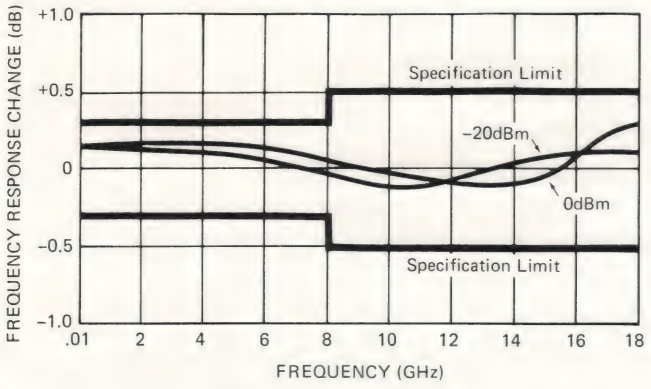
Output Polarity
Negative Polarity Standard. Positive Polarity available at no extra charge. (For Positive Polarity models, add "R" suffix to part number.)

Matched Pairs
Pairs matched within ±0.3dB from 0.01 to 18GHz are available at an extra charge of $20.00 per unit. (For matched pairs, add a 'P' after the part number for individual units—i.e., matched pairs of positive polarity D18Z3's would be ordered as D18Z3RP.)

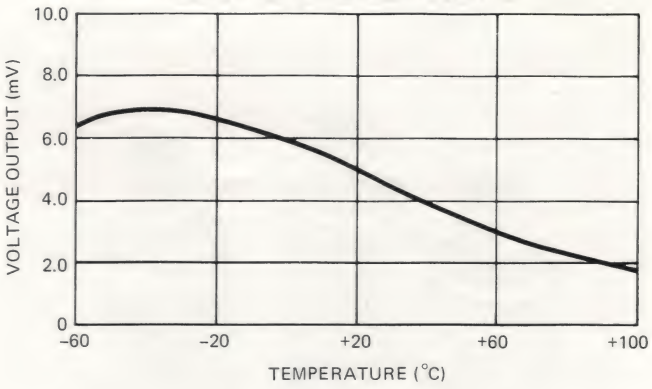
Typical Performance

Zero Bias Schottky Diode Detectors

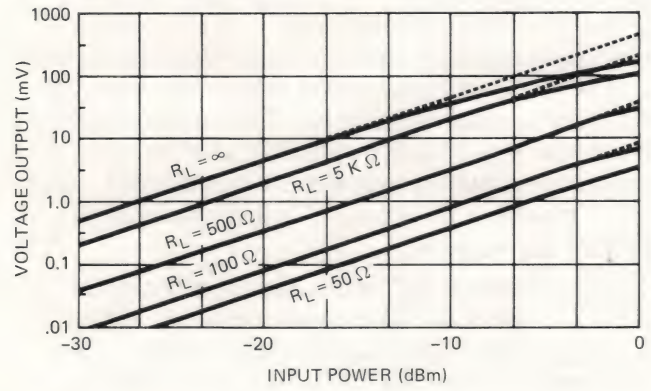
Typical Frequency Response Characteristics



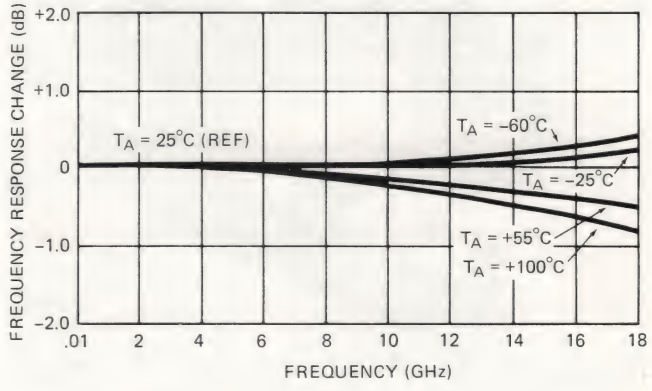
Typical Output Response with Temperature



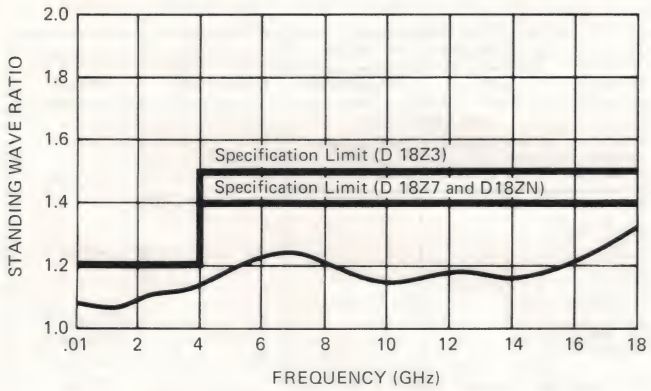
Typical Transfer Characteristics



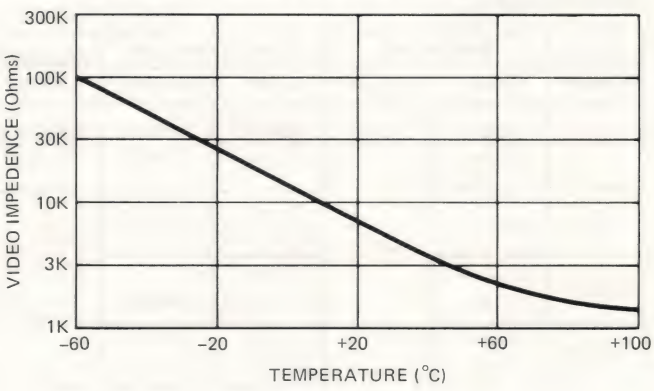
Typical Frequency Response Variation with Temperature



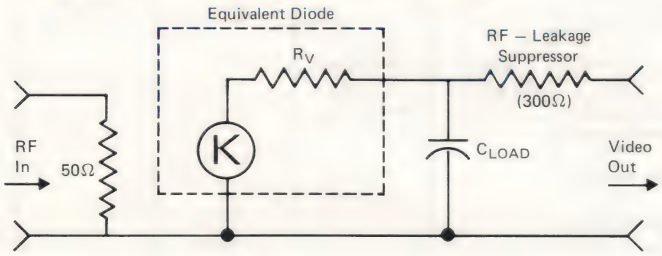
Typical Standing Wave Ratio Characteristics



Typical Video Impedance Variation with Temperature



Equivalent Circuit (D12Z, D18Z Series)

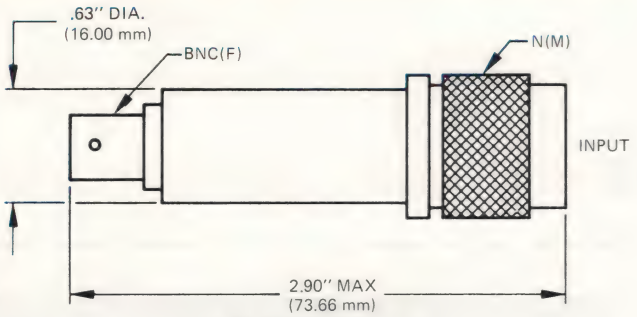


R_V (Diode Video Impedance) —	6 kΩ typical
C_{OUT} (RF Bypass Capacitor) —	10pf typical
K (Signal Generator) —	400mV/mW minimum 500mV/mW typical
T_R (10 to 90% Risetime) —	$\frac{(2.2)(R_{LOAD})(R_V)(C_{OUT}+C_{LOAD})}{R_{LOAD}+R_V}$

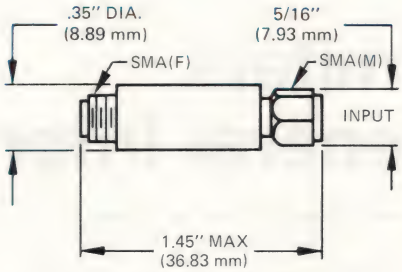
Note: Typical values are for T_A = +25°C and P_{IN} <-20 dBm

Detector Outlines

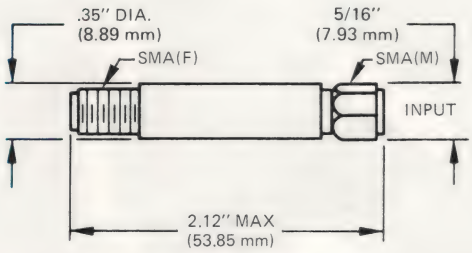
Coaxial Mounts



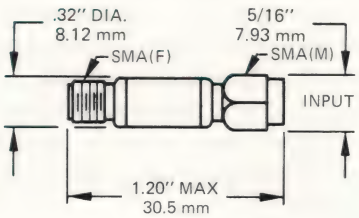
D, DT, DB Series



DMM, DOM Series

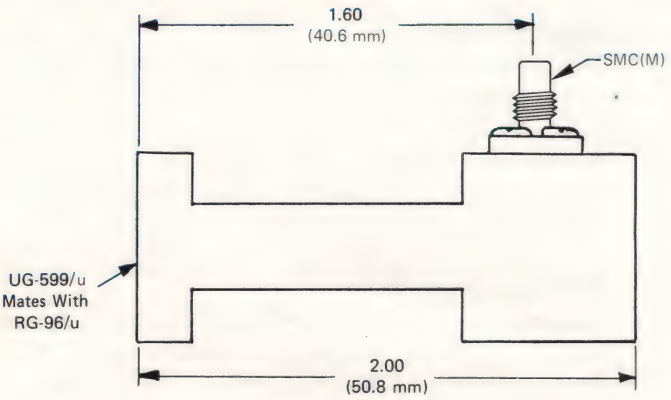


DM, DO Series

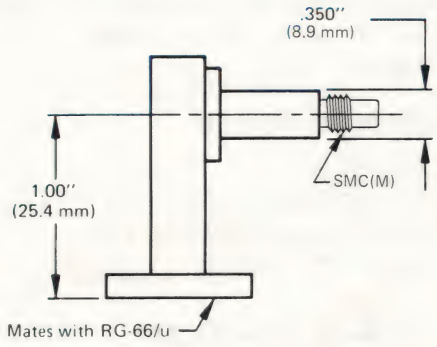


DOZ, DOS, DOX

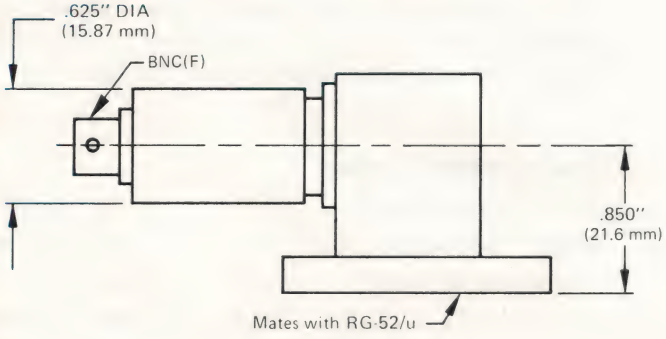
Waveguide Mounts



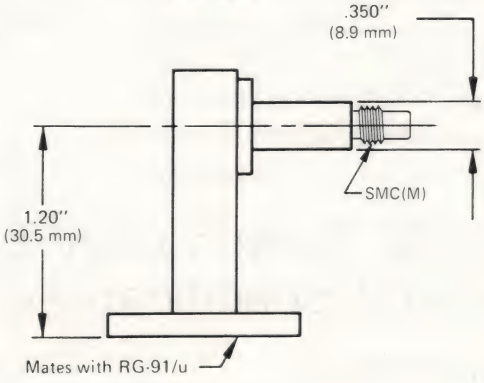
R-Band



K-Band



X-Band



KU-Band

Limiters
General Information

Aertech limiters are passive, broadband integrated circuit devices designed for receiver protection and power leveling applications. The limiter diodes are integrated into 50 ohm transmission line modules. These modules are hermetically sealed and metallurgical bonds are used to provide the reliability required by the most severe environments. The limiter modules are provided in module form for integration into coaxial or stripline circuits or with SMA connectors.

Systems applications include protection of Tunnel Diode Amplifiers, Transistor and FET Amplifiers, Mixers and Detectors in ECM, communications and radar systems.

Two specific series of limiters are shown here, however, hundreds of special units have been built to specific customer requirements. Consult the factory or local Aertech representative for more information.

A9L100 Series, Page 29

- Low Cost
- 1 Watt Capability (CW)
- Low VSWR and Insertion Loss
- Internal D.C. Returns Available

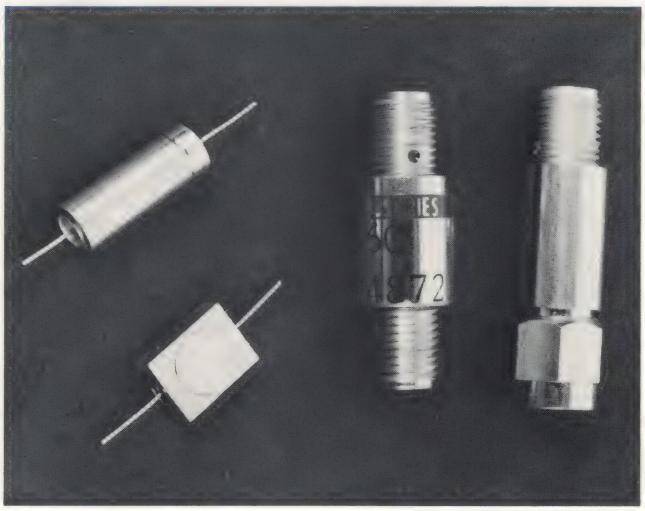
A9L200 Series, Page 30, 31

- Low Limiting Threshold (+6dBm Typical)
- High Power Handling Capability (100 Watts Pk, 1μsec, or 1 Watt CW)
- Low VSWR & Insertion Loss
- Low Leakage (20mW Typical)
- Internal D.C. Blocks Available

Limiter Terminology & General Specifications

Limiting Threshold

The incident power at which the low level insertion loss increases by one dB and the limiter begins its protective role.



Insertion Loss

The insertion loss measured at low level in the non-limiting region.

Maximum Leakage

The maximum RF power output of the limiter when one watt CW is applied at the input.

Maximum Peak Power

The maximum pulse power, applied at 1μsec pulse width and a .001 duty cycle, beyond which the limiter is likely to be damaged. In units with internal D.C. returns excessive current can also damage the return. Maximum incident power should be derated at increased ambient operating temperatures. The power specified in the specifications is for operation at 25°C. See the derating curve for other temperatures.

Environmental Ratings

Operating Temperature	−65° to +150°C
Storage Temperature	−65° to +150°C
Temperature Cycling	−65° to +150°C
Shock	1500G, 0.5 msec; 50G, 11msec
Vibration	20G, 100 to 2000Hz
Acceleration	2000G

A9L100 Series

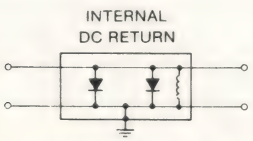
Feature	Model[4,5]	Frequency Range (GHz)	VSWR[1]		Insertion[1] Loss (dB)		Max. Leakage (1 Watt CW Input)		Limiting[2] Threshold Typical		Peak[3] Power W	Outlines[4] Available See Pg. 31
			Max.	Typ.	Max.	Typ.	mW	dBm	mW	dBm		
Broadband Without DC Return	A9L110	0.4–2.0	1.4	1.2	0.4	0.2	80	19	15	11.8	100	A1,B1,C1
	A9L112	1.0–4.0	1.4	1.3	0.8	0.5	70	18.5	11	10.4		
		4.0–8.0	1.5	1.4	1.2	1.0	40	16	10	10		A1,B1,C1, A4
		8.0–12.0	1.8	1.5	1.9	1.5	30	14.8	5	7		
	A9L111	2.0–8.0	1.5	1.4	1.5	1.0	80	19	12	10.8	70	
		8.0–18.0	2.0	1.8	2.2	1.8	60	17.8	8	9		
Narrow Band Without DC Return	A9L113	0.4–1.0	1.4	1.2	0.4	0.2	80	19	15	11.8	100	A1,B1,C1
	A9L114	1.0–2.0	1.4	1.2	0.4	0.2	80	19	15	11.8		A1,B1,C1, A4
	A9L115	2.0–4.0	1.4	1.3	0.8	0.5	70	18.5	11	10.4		
	A9L116	4.0–8.0	1.5	1.4	1.2	1.0	40	16	10	10		
	A9L117	7.0–12.0	1.8	1.5	1.9	1.5	30	14.8	5	7		
	A9L118	8.0–16.0	1.8	1.6	2.2	1.8	60	17.8	8	9	70	
	A9L119	11.0–18.0	2.0	1.8	2.2	1.8	60	17.8	8	9		
Narrow Band With DC Return	A9L122	2.0–4.0	1.4	1.3	0.8	0.5	70	18.5	11	10.4	100	A1,B1,C1
	A9L123	4.0–8.0	1.5	1.4	1.2	1.0	40	16	10	10		
	A9L125	8.0–16.0	1.8	1.6	2.2	1.8	60	17.8	8	9	70	
	A9L126	11.0–18.0	2.0	1.8	2.2	1.8	60	17.8	8	9		

Notes – A9L100

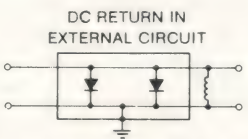
1. Unless otherwise specified, test conditions are:
   A. Temperature: +25°C
   B. Transmission Line: 50 ohm
   C. External DC return (<1 ohm) required for A9L110 through 119 types.
   D. Power level: 0 dBm for A9L100 series.
2. Point of 1 dB compression from low level insertion loss.
3. Power ratings are valid for operation at 25°C only. The derating curve defines the temperature derating factors which apply over the operating temperature range, and which can be used with power handling limits to completely define the power capability of the limiter.
   Typical recovery time for A9L100 series units is less than 100 ns.
4. Add suffix A, B, or C for package designation. See page 31.
5. Add suffix R for input SMA (F), output SMA (M).

Important – A9L100 Series

The A9L110 through A9L119 require an external DC return in order to achieve proper limiting action. The A9L122 through A9L126 have a built-in DC return. When limiters with a built-in DC return are used, no more than 50 mA of current should be allowed to flow to prevent the DC return from fusing.

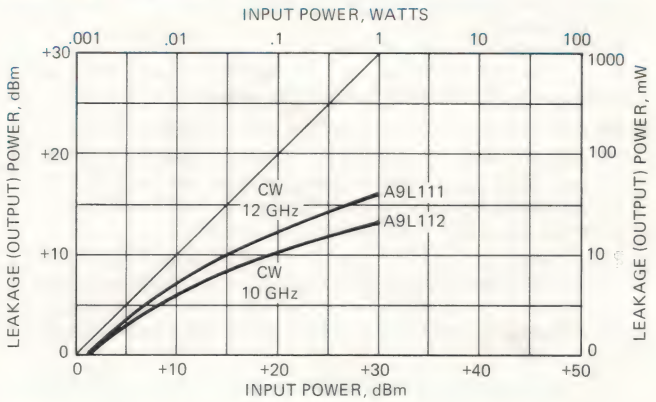


A9L122 THROUGH A9L126

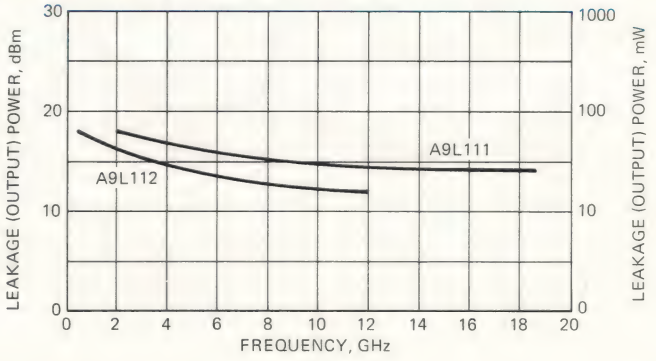


A9L110 THROUGH A9L119

A9L100 Typical Transfer Characteristic



A9L100 Typical Leakage Power vs. Frequency (+30 dBm Input)



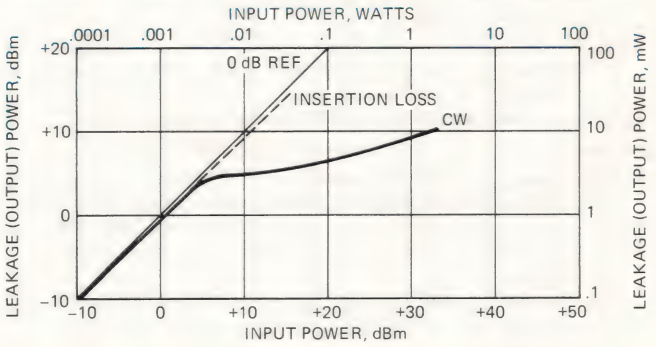
A9L200 Series

Feature	Model[6]	Frequency Range (GHz)	VSWR[1] Max.	VSWR[1] Typ.	Insertion[1] Loss (dB) Max.	Insertion[1] Loss (dB) Typ.	Max. Leakage (1 Watt CW Input) mW	Max. Leakage (1 Watt CW Input) dBm	Limiting[2] Threshold (mW) Typ.	Peak[4] Power W	Outlines[6] Available See Pg. 31
Broadband Without DC Block	A9L200	0.4–1.0	1.4	1.2	0.6	0.4	28	14.5	+4 (6 dBm)	100	A1,B1, C1
		1.0–2.0	1.4	1.3	0.6	0.4					
		2.0–4.0	1.4	1.3	0.8	0.6					
		4.0–8.0	1.5	1.4	1.2	0.8	20	13			
		8.0–12.4	1.8	1.6	1.8	1.4	17.8	12.5			
Narrow Band Without DC Block	A9L203	0.4–2.0	1.4	1.3	0.6	0.4	28	14.5			
	A9L204	2.0–4.0	1.4	1.3	0.8	0.6					
	A9L205	4.0–8.0	1.5	1.4	1.2	0.8	20	13			
	A9L206	8.0–12.0	1.8	1.6	1.8	1.4	17.8	12.5			
	A9L207	11.0–18.0	2.5	2.1	2.2	1.8	17.8	12.5			
With DC Block	A9L220	2.0–4.0	1.5	1.4	0.8	0.6	28	14.5			A2,B2, C2
		4.0–8.0	1.8	1.6	1.5	0.8	20	13			
		8.0–12.4	2.0	1.8	2.0	1.4	17.8	12.5			
	A9L224	0.4–4.0	1.4	1.3	0.8	0.6	28	14.5			
	A9L225	4.0–8.0	1.5	1.4	1.2	0.8	20	13			
	A9L226	8.0–12.4	1.8	1.6	1.8	1.4	17.8	12.5			
	A9L227	11.0–18.0	2.5	2.1	2.5	2.0	17.8	12.5			

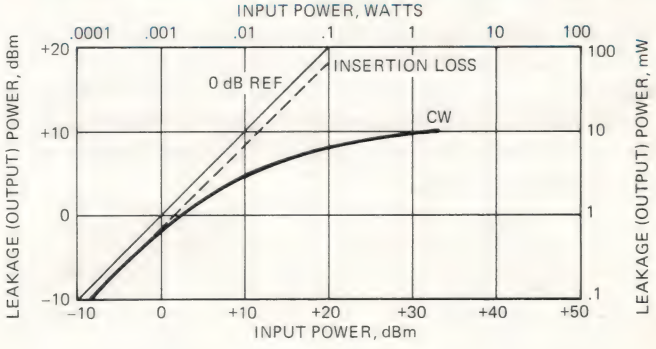
Notes – A9L200

1. Unless otherwise specified, test conditions are:
   A. Temperature: +25°C
   B. Transmission Line: 50 ohm
   C. External DC Blocks required for A9L200 through 207 types.
   D. Power level: –10 dBm for A9L200 series.
2. Point of 1 dB compression from low level insertion loss.
3. For A9L200 series, designated ports must be used for Input & Output. For B1 & B2 outline types, the male connector is RF Input unless otherwise specified. Suffix "R" signifies RF Input at female connector (for example A9L220BR)
4. Power ratings are valid for operation at 25°C only. The derating curve defines the temperature derating factors which apply over the operating temperature range, and which can be used with power handling limits to completely define the power capability of the limiter.
5. Typical recovery time for A9L200 series units is less than 10μS.
6. Add suffix A, B, or C for package designation. See Page 31.

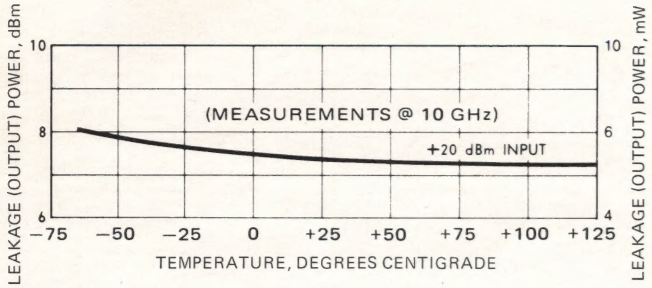
A9L200 Typical Transfer Characteristics – 2.0 GHz

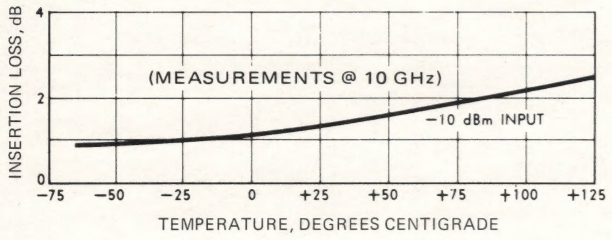


A9L200 Typical Transfer Characteristics – 12.0 GHz

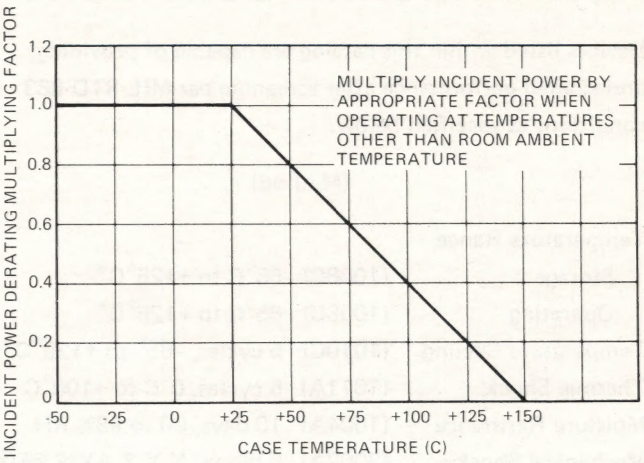


A9L200 Typical Temperature Performance



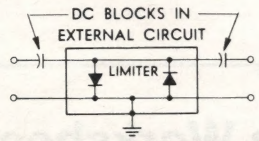


Temperature Derating of Incident Power

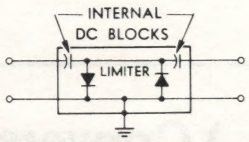


Important – A9L200 Series

DC blocks are required on both RF input and RF output in order to achieve proper limiting action. DC blocks must be provided on both input and output of A9L200 through 207 models. DC blocks are provided internally on A9L220 series models.

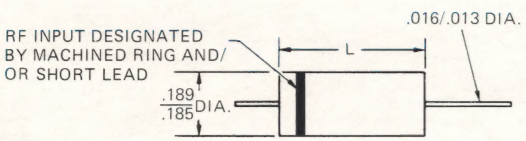


A9L200 THROUGH A9L207

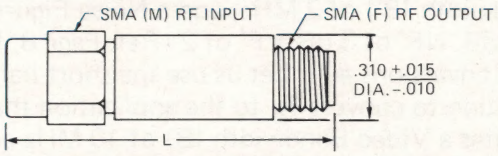


A9L220 THROUGH A9L227

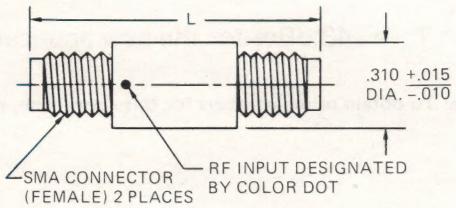
Outlines



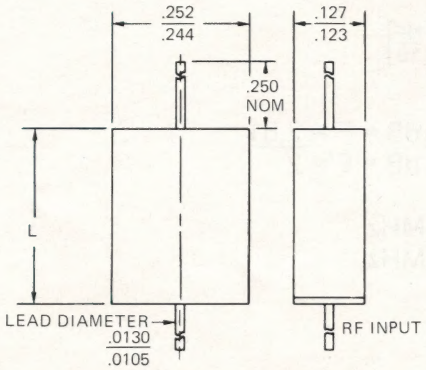
Outline A1 L = .440/.420
Outline A2 L = .540/.520
Outline A3 L = .820/.780



Outline B1 L = 1.08/1.04
Outline B2 L = 1.18/1.14
Outline B3 L = 1.46/1.42



Outline C1 L = 1.03/1.00
Outline C2 L = 1.13/1.10
Outline C3 L = 1.41/1.37



Outline A4 L = .333/.327
Outline A5 L = .533/.527

Outline A4 and A5—available on only certain models. Contact Aertech for more information.

Environmental Conditions

Devices listed within this catalog are capable of providing undegraded performance after screening per MIL-STD-883 conditions as specified below:

	(Method)	
Temperature Range		
Storage	(1008C)	-65°C to +125°C*
Operating	(1008C)	-65°C to +125°C*
Temperature Cycling	(1010C)	5 cycles, -65° to +125°C*
Thermal Shock	(1011A)	5 cycles, 0°C to +100°C
Moisture Resistance	(1004A)	10 days, 90 to 98% RH
Mechanical Shock	(2002A)	5 blows, X,Y,Z AXIS @50G's
Variable Freq. Vib.	(2007A)	100 to 2000 Hz
Constant Accel.	(2001A)	X,Y,Z AXIS @ 20,000 G's**

*Temperature as shown is for all devices listed within this catalog, with the exception of Tunnel Diode Detectors and Isotectors. The maximum temperature ranges are listed within the applicable sections for each device type.

**Constant acceleration level as listed, is for devices of "Modular Construction" (i.e. A9A816B, A9M100BR, A9L110B) that are listed within this catalog. The constant acceleration limit for packaged diode structures (i.e. DOM812B, D812BS, DIS816B) is 500G.

Tangential Signal Sensitivity (T_{SS}) Conversion Worksheet

All values of T_{SS} in this catalog have been specified and measured with a video amplifier having a Bandwidth (B') of 2 MHz, and a Noise Figure (NF') of 3 dB. NF' of 3 dB = F' of 2 (Ref. Page 8, Example Conversions #1). Let us use the short hand equation to convert T_{SS} to the application that dictates a Video Bandwidth (B) of 10 MHz and a Noise Figure (NF) of 4 dB.

To convert NF to F, use the equation

$$F = 10^{\left[\frac{NF}{10}\right]}$$

$$NF = 4\ dB = F = 2.51$$
$$NF' = 3\ dB = F' = 2$$

$$B = 10\ MHz$$
$$B' = 2\ MHz$$

Calculate the T_{SS} for the New Application as:

$$T_{SS} = T_{SS}' + 10 \log \sqrt{\frac{B}{B'} X \frac{F}{F'}}$$

If T_{SS}' was -52 dBm, the result of the calculation is:

T_{SS} = -48 dBm for the new application

Note: To obtain prime numbers for this conversion, refer to Page 8.

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- FET

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Ferrites
- Isolators
- Circulators

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Limiters
LOG Video Amplifiers
MIC Subsystems
Microwave Diodes
- Schottky
- PIN
- Silicon Step Recovery
- Tunnel

Microwave Radio RF Units
Mixers/Mixer Preamplifiers
Polar Discriminators
Switches
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Video Amplifiers

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